DOCUMENT RESUME

ED 123 070 SE 020 634

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TITLE Individualized Math Problems in Fractions. Oregon Vo-Tech Mathematics Problem Sets.
INSTITUTION Oregon Math Education Council, Salem.; Oregon State Dept. of Education, Salem. Career and Vocational Education Section.
PUB DATE 74
NOTE 118p.; For related documents, see SE 020 628-648; Occasional Marginal Legibility
AVAILABLE FROM Continuing Education Publications, P.O. Box 1491, Portland, Oregon 97207

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Fractions; Individualized Instruction; *Instructional Materials; Mathematical Applications; Mathematics Education; Numbers; *Problem Sets; Secondary Education; *Secondary School Mathematics; *Vocational Education
IDENTIFIERS *Oregon Vo Tech Math Project

ABSTRACT

This is one of eighteen sets of individualized mathematics problems developed by the Oregon Vo-Tech Math Project. Each of these problem packages is organized around a mathematical topic and contains problems related to diverse vocations. Solutions are provided for all problems. This package contains problems involving computation with common fractions and conversion of fractions to decimals. The problems are drawn from twnety vocational areas: food processing, marketing, real estate, drafting, machine tools, industrial mechanics, nursing, forestry, agriculture, fire and police science, welding, aviation mechanics, industrial, electrical, and hydraulics technology, diesel mechanics, clerical work, construction, wastewater technology, auto mechanics, wood products, and electronics. (SD)

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I
L INDIVIDUALIZED
LEARNING
S SYSTEMS

Individualized Math Problems in

Fractions

Oregon Vo-Tech Mathematics Problem Sets

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SE 020 034

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Individualized Learning Systems

MATHEMATICS

Fractions

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The host school for this project was Linn-Benton Community College, Albany, Oregon. The project was funded by two sources: the Oregon Math Education Council (OMEC) and through Part D Federal Funds, under contract for the Division of Instructional Support-Career Education, Oregon State Department of Education, under the authority of the Vocational Education Act of 1963 as amended in 1968. Questions regarding use, reproduction, or availability of these materials should be addressed to the Curriculum Coordinator, State Department of Education, 942 Lancaster Drive NE., Salem, Oregon 97310.

B. Problem without Solution

1. If the drying time for prunes is 72 hours and a drying area of 382,000 sq ft in this dryer. How many tons of prunes can the operator dry in a 24 hour period if the load factor is two pounds per square foot? (The dried prunes weigh 1/3 the weight of the fresh plums.)

Complete Solution to B Problem

1. Prunes dried = (1/3) $\left[\frac{(382{,}000 \text{ sq ft})(2 \text{ lbs/sq ft})}{2{,}000 \text{ lbs/ton}}\right]$ $\left(\frac{24 \text{ hrs/day}}{72 \text{ hrs}}\right)$

= 42.4 tons/day

A. Problems with Solutions

1. Compute and check the net change during the month of February of your stock positions, assuming they are as follows:

	Price, Jan 31	Price, Feb 28	Change
UNITED ELECTRIC	62 5/8	68 3/4	_____
GENERAL OIL	22	25 3/8	_____
TOTALS	_____	_____	_____

(NOTE: By filling in the blanks above, you will be solving the problem as stated.)

Solution:

United Electric change = 68 3/4 - 62 5/8

= 68 6/8 - 62 5/8 = 6 1/8

General Oil change = 25 3/8 - 22 = 3 3/8

Total change = 6 1/8 + 3 3/8 = 9 4/8 = 9 1/2

To check:

Total change = sum of Feb 28 prices - sum of Jan 31 prices

= (68 3/4 + 25 3/8) - (62 5/8 + 22)
= (68 6/8 + 25 3/8) - 84 5/8
= 93 9/8 + 84 5/8
= 9 4/8 = 9 1/2

2. By selling eggs at 45¢ a dozen, you make a profit of 2/3¢ per egg. How much profit would you make per egg by selling them at 48¢ per dozen?

Solution:

Selling proce per egg at 45¢ per dozen = $\frac{\$0.45/\text{doz}}{12\ \text{eggs/doz}}$

= 3 2/3¢ per egg

Selling price per egg at 48¢ per dozen = $\frac{\$0.48/\text{doz}}{12\ \text{eggs/doz}}$

= 4¢ per egg

A. Problems with Solutions (continued)

2. Solution: (continued)

Profit increase per egg = 4¢ - 3 2/3¢

= 12/3¢ - 11/3¢ = 1/3¢

Total profit per egg at 48¢ per dozen = 2/3¢ + 1/3¢ = 1¢

3. An inventory count in the yardage department of a retail store indicated that there were 6 rolls of #216 gingham containing 16 1/8, 27 4/8, 36 2/8, 45 3/8, 50 7/8 and 42 3/8 yards, respectively. At $2 a yard, what was this stock worth?

Solution:

16 1/8 yards
27 4/8 yards
36 2/8 yards
45 3/8 yards
50 7/8 yards
42 3/8 yards
+

Total 216 20/8 yards = 218 1/2 yards

Total worth = (218 1/2 yds)($2/yd)

= (437/2 yds)($2/yd) = $437

4. Mr. Brown owned 3/7 of a store. He sold 1/3 of his share for $13,000. At the same rate, what was the value of the store?

Solution:

He sold 1/3 of 3/7 = (1/3)(3/7) = 1/7

x = value of the store

(1/7)x = $13,000

x = ($13,000)(7)

x = $91,000

B. Problems without Solutions

5. A company packs its cat food in cans containing 13 1/2 oz of cat food. Each can weighs 1 3/4 oz. Two dozen cans are packed in a carton weighing 12 oz. What is the shipping weight of one carton?

6. A merchant typically sells 1,000 baseball bats per month at $4 each. He decides to increase the price per bat by 1/4, and this in turn decreases his total sales volume by 1/5. Will he make more, less, or the same amount of profit at the new price? (Assume that his expenses remain constant.)

7. Tom, Dick and Harry make a profit of $3,600 in a joint investment venture. Tom gets 1/2, Dick gets 1/3 and Harry gets 1/6 of the total profit. How much does each man get?

B. Problems without Solutions (continued)

8. Unroasted coffee costs $0.72 per pound, and shrinks to 4/5 of its original weight when roasted. How much will it cost to buy enough unroasted coffee for 10 lb of roasted coffee?

9. Four men - Brown, Cole, May and Ward - each owns 1/4 of a business. Brown sells 1/3 of his share to Cole and the rest to May. What part does each of the three remaining partners now own?

10. A grocer bought 255 3/4 pounds of bacon which he divided into 1/2 pound packages. How many packages did he have for sale?

B. Problems without Solutions (continued)

11. If it required 16 weeks at 40 hours per week for 22 men to complete a job, how many weeks would it take them to complete the same job working 56 hours if they accomplish (a) the same amount per hour, (b) only 9/10 as much per hour when working longer hours?

12. A man worked the following number of hours each day during a 5 day week: 6 1/2 hours, 7 3/4 hours, 8 1/2 hours, 9 1/4 hours and 7 2/3 hours, respectively. How many hours did he work and how much did he earn if he was paid at the rate of $6 an hour?

B. Problems without Solutions (continued)

13. Mr. Bradshaw bought 200 used tires for $175 at an auction. He sold 1/4 of them for $60.00; 16 tires at $7.50 each; 51 tires at $10.00 each and junked the rest. How many tires did he throw away? What was his total profit if the cost of handling this transaction amounted to $65.00?

14. A businesswoman invested $1,533 to buy shares of a stock that cost 27 3/8 dollars per share. How many shares did she buy?

15. Three and five-eighths yards of fabric are required to manufacture a certain type of jacket. How many jackets can be made from 4,350 yards of fabric?

B. Problems without Solutions (continued)

16. Mr. Eaton, Mr. Hayes, and Mr. Huff owned a business jointly and shared profits and losses in proportion to their investments which were $25,000, $15,000, and $30,000 respectively. What fractional part did each man own in the business? If profits amounted to $2,688 for the current year, how much did each man receive as his share?

Complete Solutions to B Problems

5. Total weight of cat food = (13 1/2 oz/can)(24 cans)

= (27/2 oz/can)(24 cans) = 324 oz

Total weight of cans = (1 3/4 oz/can)(24 cans)

= (7/4 oz/can)(24 cans) = 42 oz

Shipping weight = 324 oz + 12 oz + 12 oz = 378 oz

Since there are 16 oz in one lb, the shipping weight of one carton is 23 lbs 10 oz.

6. At first glance, there might be a temptation to compare the two fractions 1/4 and 1/5, and conclude that the merchant makes more profit since 1/4 is larger than 1/5. Let's look more closely.

Compare the total sales before and after the price increase:

Sales before increase = (old volume)(old price)

= (1,000 bats)($4/bat) = $4,000

Sales after increase = (new volume)(new price)

= [1,000 bats - (1/5)(1,000 bats)] [$4+(1/4)($4)]

= (1,000 bats - 200 bats)($4 + $1)

= (800 bats)($5) = $4,000

Conclusion: Profit after increase is same as profit before

7. Tom's portion = (1/2)($3,600) = $1,800

Dick's portion = (1/3)($3,600) = $1,200

Harry's portion = (1/6)($3,600) = $600

Complete Solutions to B Problems (continued)

8. First, find how many lbs of unroasted coffee is needed to make 10 lbs of roasted:

c = lbs of unroasted coffee

(4/5)c = 10 lbs

c = (10 lbs)(5/4)

c = 50/4 lbs = 25/2 lbs

Total cost = (lbs of unroasted coffee)(cost per lb)

= (25/2 lbs)($0.72/lb) = $9.00

9. Ward still owns 1/4 of the business

Cole's share = 1/4 + (1/3)(Brown's share)

= 1/4 + (1/3)(1/4)

= 1/4 + 1/12 = 3/12 + 1/12 = 4/12 = 1/3

May's share = 1/4 + (2/3)(Brown's share)

= 1/4 + (2/3)(1/4)

= 1/4 + 2/12 = 3/12 + 2/12 = 5/12

10. Number of packages = $\frac{\text{total pounds}}{\text{pounds per package}}$

$= \frac{255\ 3/4\ \text{lbs}}{1/2\ \text{lb/package}}$

$= \left(\frac{1023}{4}\ \text{Package}\right)(2) = 511\ 1/2\ \text{packages}$

The grocer is able to prepare 511 half pound packages of bacon for sale.

Complete Solutions to B Problems (continued)

11. The number of men working is not really important, assuming that each does an equal share of the job. So, calculate the answer using what one man does in 16 weeks at 40 hours per week.

(a) Total hours worked = (16 weeks)(40 hrs/week) = 640 hrs

Weeks needed working 56 hrs = $\frac{640 \text{ hrs}}{56 \text{ hrs/week}}$ = 11 3/7 weeks

(b) For this part, only 9/10 of the job is done after 11 3/7 weeks. So, 11 3/7 weeks is 9/10 of the total number of weeks:

11 3/7 weeks = (9/10)W

W = (80/7 weeks)(10/9)

W = $\frac{800}{63}$ weeks

W = 12 44/63 weeks

12. Hours worked = 6 1/2 hrs + 7 3/4 hrs + 8 1/2 hrs + 9 1/4 hrs + 7 2/3 hrs

= 6 6/12 hrs + 7 9/12 hrs + 8 6/12 hrs + 9 3/12 hrs + 7 8/12 hrs

= 37 32/12 hrs = 39 8/12 hrs = 39 2/3 hrs

Earnings = (39 2/3 hrs)($6/hr)

= (119/3 hrs)($6/hr)

= $238

13. Tires thrown away = 200 tires - tires sold

= 200 tires - [(1/4)(200 tires) + 16 tires + 51 tires]

= 200 tires - (50 tires + 16 tires + 51 tires)

= 200 tires - 117 tires

= 83 tires

Complete Solutions to B Problems (continued)

13. (continued)

Profit = total income - expenses

$$= \left[\$60 + (16 \text{ tires})(\$7.50/\text{tire}) + (51 \text{ tires})(\$10/\text{tire})\right] - (\$175 + \$65)$$

$$= (\$60 + \$120 + \$510) - \$240$$

$$= \$690 - \$240$$

$$= \$450$$

14. $$\text{Share bought} = \frac{\text{investment}}{\text{price per share}}$$

$$= \frac{\$1,533}{\$27\ 3/8 \text{ share}}$$

$$= (1,533)\left(\frac{8}{219} \text{ shares}\right)$$

$$= 56 \text{ shares}$$

15. $$\text{Number of jackets} = \frac{\text{total yardage}}{\text{yards per jacket}} = \frac{4,350 \text{ yds.}}{3\ 5/8 \text{ yds/jacket}}$$

$$= (4,350)(8/29 \text{ jacket})$$

$$= 1,200 \text{ jackets}$$

16. Total amount invested = \$25,000 + \$15,000 + \$30,000 = \$70,000

$$\text{Eaton owns} = \frac{\$25,000}{\$70,000} = \frac{5}{14}$$

$$\text{Hayes owns} = \frac{\$15,000}{\$70,000} = \frac{3}{14}$$

$$\text{Huff owns} = \frac{\$30,000}{\$70,000} = \frac{3}{7}$$

Eaton's profit = (5/14)(\$2,688) = \$960

Hayes' profit = (3/14)(\$2,688) = \$576

Huff's profit = (3/7)(\$2,688) = \$1,152

A. Problems with solutions.

1. On Jan. 1 Robert Harris paid his taxes of $360 for the calendar tax year of Jan 1 to Dec. 31. On March 15, Robert sold his home.

   a) What sum of money would Robert receive from the buyer for taxes?

   b) What sum of money would Robert receive for taxes if he sold his home October 15?

Solution:

a) $360 ÷ 12 = $30 per month

1/2 of March, April, May, June, July, Aug, Sept, Oct, Nov, and Dec = 9 1/2 months

(9 1/2 month)($30/month) = $285

b) 1/2 of Oct., Nov., Dec., = 2 1/2 months

(2 1/2 months) ($30/month) = $75

2. A building is insured for $24,500. The annual fire insurance rate is $0.16 per $100. The owner purchased a three year policy for 2 1/2 times the annual rate. What would the cost of his 3 year premium be? Write answer as cents per $100.

Solution:

1 year = $0.16 per $100

3 year = (2 1/2)($0.16) = $0.40 per $100

3. a) three months is what fraction of a year?

   b) four months is what fraction of a year?

Solution:

a) $(3 \text{ months}) \left(\frac{1 \text{ year}}{12 \text{ month}}\right) = 3/12 \text{ year} = 1/4 \text{ year}$

b) $(4 \text{ months}) \left(\frac{1 \text{ year}}{12 \text{ month}}\right) = 4/12 \text{ year} = 1/3 \text{ year}$

B. Problems without solutions.

4. For the fiscal tax year of July 1 to June 30, the taxes of $180 are paid on a home. The property is sold March 1. What would the buyer owe the seller for taxes?

5. The calendar tax year is January 1 to Dec. 31. The taxes are unpaid and the property is sold Feb. 15.

   (a) How many months of tax monies would the seller owe the buyer?
   (b) How many months have been prepaid if the taxes were paid and the tax year was Jan 1 to Dec. 31?

6. For the calendar tax year Jan 1 to Dec 31, taxes of $300 are paid. The property is sold March 15.

   (a) What is the value of the prepaid portion?
   (b) What would the credit to the buyer be if the taxes had not been paid?

B. Problems without solutions, continued.

7. (a) 3 1/2 months is what fraction of a year?
   (b) 7 1/2 months is what fraction of a year?

8. For the fiscal tax year July 1 to June 30, the taxes of $360 are paid on a home. The property is sold Feb. 1. What would the buyer owe the seller for taxes?

9. The taxes of $480 have been paid for the calendar year on a home that is sold August 15. What amount of money will the seller receive for his share of the taxes?

B. Problems without solutions, continued.

10. (a) 7 months is what fraction of a year?

(b) 8 1/2 months is what fraction of a year?

Complete solutions to B problems.

4. ($180/year) (1 year/12 months) = $15/month

   March 1 to June 30 is 4 months

   (4 months) ($15/month) = $60

5. a) Jan 1 to Feb 15 is 1 1/2 months

   b) Feb 15 to Dec 31 is 10 1/2 months

6. a) ($300/year)(1 year/12 months) = $25/month

   From March 15 to Dec. 31 is 9 1/2 months

   (9 1/2 months) ($25/month) = $237.50

   b) $300 - $237.50 = $62.50

7. a) (3 1/2 months) (1 year/12 months)

   = (7/2 months) (1 year/ 12 months)

   = 7/24 year

   b) (7 1/2 months) (1 year/12 months)

   = (15/2 months) (1 year/12 months)

   = 15/24 years

8. ($360/year)(1 year/12 months) = $30.00/month

   Feb 1 to June 30 is 4 months

   (4 months) ($30.00/month) = $120.00

9. ($480/year)(1 year/12 months) = $40/month

   August 15 to Dec. 31 is 4 1/2 months

   (4 1/2 months)($40/month) = $180.00

Complete solutions to B problems, continued.

10. a) (7 ~~months~~) (1 year/12 ~~months~~) = 7/12 year

b) (8 1/2 months) (1 year/ 12 months) =

(17/2 ~~months~~) (1 year/12 ~~months~~) = 17/24 year

A. Problems with solutions.

1. Locate and shade in the areas on the section map below of the legally described parcels of real estate.

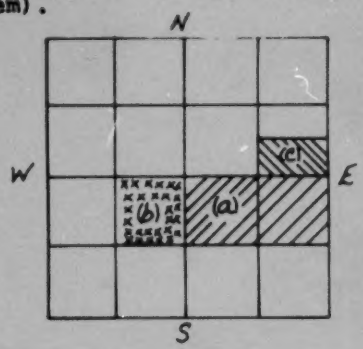
   (a) N1/2 of the SE1/4

   (b) NE1/4 of the SW1/4

   (c) S1/2 of the SE1/4 NE1/4

(Note: The easiest way to describe these is to read from right to left. Or read from largest area described to the smallest area described. This is called the Government Survey System).

Solution:



2. The section above contains 640 acres. How many acres in (a),(b),& (c)?

Solution:

a) N1/2 SE1/4

SE1/4 =(1/4) (640acres/1) = 160 acres

N1/2 = (1/2)(160 acres/1) = 80 acres (answer)

b) NE1/4 SW1/4

SW1/4 = (1/4)(640acres/1) = 160acres

NE1/4 = (1/4) (160 acres/1)= 40 acres

c) S1/2 SE1/4 NE1/4

NE1/4 =(1/4) (640acres/1) = 160 acres

A. Problems with solutions.

2. continued.

c. continued.

SE 1/4 = (1/4)(160 acres/1) = 40 acres

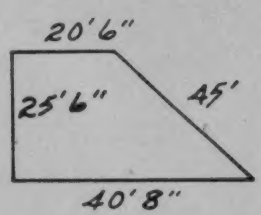
S 1/2 = (1/2)(40 acres/1) = 20 acres

B. Problems without solutions.

3. An acre is what fraction of a square mile?

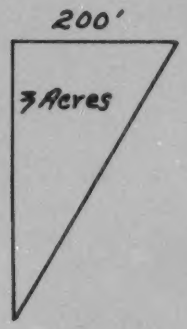
4. What is the square footage in a parcel of land 59 feet 8 inches wide and 120 feet deep?

5. Find the square footage of the following parcel of land in the shape of a trapezoid.



B. Problems without solutions.

6. Find the depth of the property described below:



7. A room measuring 12' 6" by 18' 4" contains how many square feet?

8. How many acres are in the following rectangular legal descriptions of a section. (Note: rectangular legal and Government survey are synonymous)

   a) W1/2 of NE1/4 of NE1/4

   b) SW1/4 of SW1/4

   c) N1/2 of S1/2 of NE1/4 of SW1/4

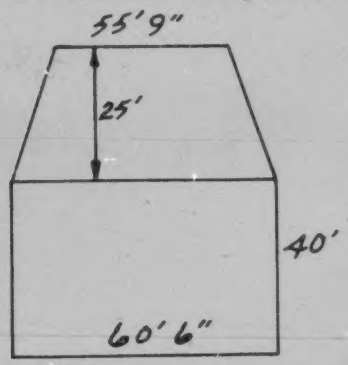
   d) W1/2 of S1/2 of S1/2 of NE1/4

B. Problems without Solutions

9. What is the cost of the following parcel of land if the cost per acre is $20?

   the NW1/4 of the SW1/4 of the NE1/4 of a section.

10. Find the area of the parcel of land described below.



11. A section is what fraction of a township?
    (Note: There are 36 sections in a township)

B. Problems without solutions.

12. How many cubic yards of sand would be needed to fill a trench 12 yards long, 3 yards wide, and 1/2 yard deep?

13. A farm has how many acres if 1/8 is in lawn, 1/4 in timber and the remaining 50 acres is in pasture?

14. How many acres are in the following legal descriptions of a parcel within a section.

    (a) NW1/4 of the NW1/4

    (b) S1/2 of the NE1/4 of the SW1/4 of the SW1/4

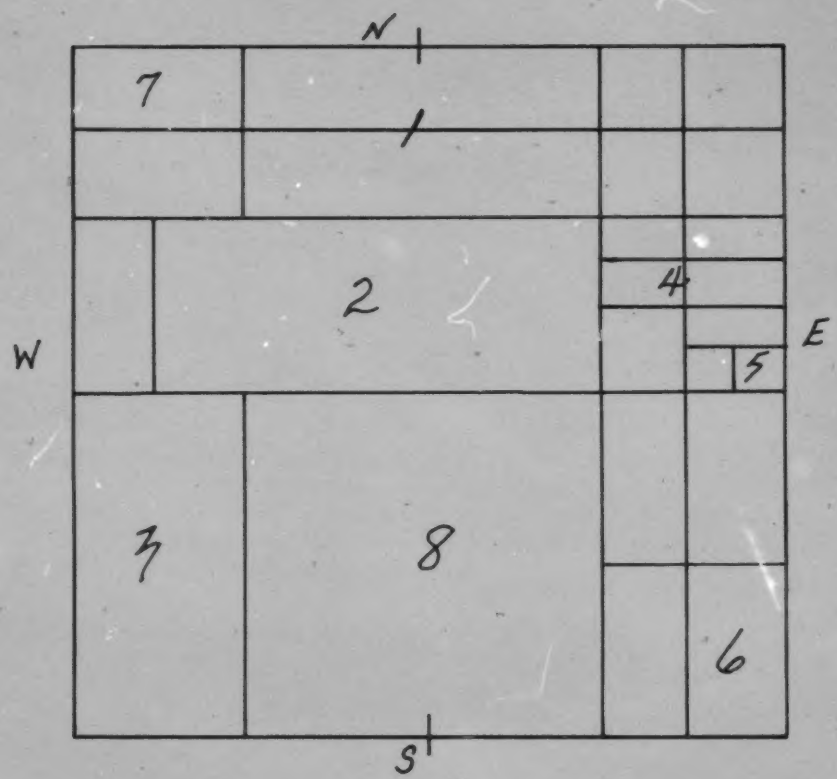
    (c) W1/2 of the SE1/4

15. How many acres are there in 1/50 of a section?

B. Problems without solutions.

16. A basement 20' by 30' and 5' high would contain howm many cubic yards?

17. Give complete legal description and the number of acres in each parcel 1 through 8. (Hint: Use a semicolon or the word "and" when encompassing more that one quarter.)



Complete solutions to B problems.

3. There are 640 acres in a section and a section is 1 square mile. So, an acre is 1/640 of a section.

4. Area = (length)(width)

= (59 2/3 ft)(120 ft)

= 7160 sq ft.

5. The area of a trapezoid is equal to 1/2 the product of the altitude and the sum of the two bases (the parallel sides).

Area = 1/2 (25 1/2') (20 1/2' + 40 2/3')

= 1/2 (25 1/2') (61 1/6')

= 1/2 (51/2')(367/6')

= 779 21/24 sq ft = 779 7/8 sq ft

6. Area of a triangle is 1/2 (base)(height)

3 acres = N sq ft

(3 ~~Acres~~)(43560 sqft/~~acre~~) = 130680 sq ft

1/2 (200')(height) = 130680 sq ft

height = 1306 4/5 ft

7. Area = (length) (width)

= (12 1/2)(18 1/3')

= (25/2') (55/3')

= 1375/6 sq ft

= 229 1/6 sq. ft.

Complete solutions to B problems, continued.

8. a) (640 acres)(1/4) = 320 acres

(320 acres)(1/4) = 80 acres

(80 acres)(1/2) = 20 acres

b) (640 acres)(1/4) = 160 acres

(160 acres)(1/4) = 40 acres

c) (640 acres)(1/4) = 160 acres

(160 acres)(1/4) = 40 acres

(40 acres)(1/2) = 20 acres

(20 acres)(1/2)

d) (640 acres)(1/4) = 160 acres

(160 acres)(1/2) = 80 acres

(80 acres)(1/2) = 40 acres

(40 acres)(1/2) = 20 acres

9. (640 acres) (1/4) = 160 acres

(160 acres) (1/4) = 40 acres

(40 acres) (1/4) = 10 acres

(10 acres) ($20/acre) = $200

10. Work this by solving for the area of the rectangle, then the trapezoid and add these areas together.

Area of the rectangle = (60 1/2')(40)

= 2420 sq. ft.

Area of the trapezoid = 1/2 (25')(55 3/4' + 60 1/2')

= 1/2 (25')(116 1/4)

= 1453 1/8 sq ft

Total area = 1453 1/8 sq ft + 2420 sq ft

= 3873 1/8 sq ft

11. Since there are 36 sections in a township, 1 section is 1/36 of a Township.

Complete solutions to B problems, continued.

12. Volume = (length) (width) (depth)

= (12 yds) (3 yds) (1/2 yd)

= 18 cu yds.

13. The amount not in pasture = 1/8 (in lawn) + 1/4 (in timber)

= 3/8 not in pasture

50 acres in pasture = 5/8

5/8 (total area) = 50 acres

$$\text{total area} = \frac{50 \text{ acres}}{5/8}$$

= 80 acres

14. a) (640 acres) (1/4) = 160 acres

(160 acres) (1/4) = 40 acres

b) (640 acres) (1/4) = 160 acres

(160 acres) (1/4) = 40 acres

(40 acres) (1/4) = 10 acres

(10 acres) (1/2) = 5 acres

c)

(640 acres) (1/4) = 160 acres

(160 acres) (1/2) = 80 acres

15. A section is 640 acres, so

(1/50) (640 acres) = 640/50 acres

= 12 4/5 acres

16. Volume = (length) (width) (height)

= (20') (30') (5')

= 3000 cu ft

Complete Solutions to B Problems

16. con't. $(3000\ \text{cu ft})\left(\frac{1\ \text{cu yard}}{27\ \text{cu feet}}\right) = \frac{3000}{27}$ cu yards

= 111 1/9 cu yds

17. (1) NW 1/4 of the NE 1/4 and NE 1/4 of the NW1/4

(640 acres)(1/4) = 160 acres

(160 acres)(1/4) = 40 acres

same area for the other parcel

Total area = 40 acres + 40 acres = 80 acres

(2) SE 1/4 of the NW 1/4 and SW 1/4 of the NE 1/4 and E 1/2 of the SW 1/4 of the NW 1/4.

(640 acres) (1/4) = 160 acres

(160 acres) (1/4) = 40 acres

same area for SW 1/4 of the NE 1/4

(640 acres)(1/4) = 160 acres

(160 acres)(1/4) = 40 acres

(40 acres)(1/2) = 20 acres

Total area = 40 acres + 40 acres + 20 acres = 100 acres

(3) W 1/2 of the SW 1/4

(640 acres)(1/4) = 160 acres

(160 acres)(1/2) = 80 acres

Total area = 80 acres.

(4) S 1/2 of the N 1/2 of the SE 1/4 of the NE 1/4

(640 acres)(1/4) = 160 acres
(160 acres)(1/4) = 40 acres
(40 acres)(1/2) = 20 acres
(20 acres)(1/2) = 10 acres

Total area = 10 acres

Complete solutions to B problems, continued.

17. continued.

5. SE 1/4 of the SE 1/4 of the SE 1/4 of the NE 1/4

(640 acres) (1/4) = 160 acres

(160 acres) (1/4) = 40 acres

(40 acres) (1/4) = 10 acres

(10 acres) (1/4) = 21/2 acres

Total area = 2 1/2 acres

6. E 1/2 of the SE 1/4 of the SE 1/4

(640 acres)(1/4) = 160 acres

(160 acres)(1/4) = 40 acres

(40 acres)(1/2) = 20 acres

Total area = 20 acres

7. N 1/2 of the NW 1/4 of the NW 1/4

(640 acres)(1/4) = 160 acres

(160 acres)(1/4) = 40 acres

(40 acres)(1/2) = 20 acres

8. E 1/2 of the SW 1/4 ad

E 1/2 of the SW 1/4 and W 1/2 of the SE 1/4

(640 acres)(1/4) = 160 acres

(160 acres)(1/2) = 80 acres

(640 acres)(1/4) = 160 acres

Total Area = (160 acres)(1/2) = 80 acres

B. Problems without solutions.

The abbreviation for the board foot is fbm, which actually reads feet board measure.

The rule for calculating the fbm in a piece of lumber:

> Place the standard cross section dimensions over 12 in fractional form and multiply the answer by the length and the number of pieces.

Find the fbm in 60 pieces of 2" x 8" x 14' =

$$\left(\frac{(2")\ (8")}{12\ \text{in/ft}}\right)\ (14")\quad (\ 5\ \text{boards}) = \underline{1120}\ \text{fbm}$$

Problems

1. Calculate the fbm in the following lumber bill of materials:

75	pcs.	1" x 6" - 16'
80	"	1" x 8" - 12'
40	"	2" x 4" - 16'
20	"	2" x 8" - 10'
20	"	2" x 12" - 12'
30	"	3" x 6" 10'
40	"	4" x 8" - 16'
60	"	6" x 10" - 18'
10	"	8" x 8" - 16'

Complete solutions to B problems.

1. $\left(\frac{(1")(6")}{12\ in/ft}\right)$ (16') (75 boards) = 600 fbm

$\left(\frac{(1")(8")}{12\ in/ft}\right)$ (12') (80 boards) = 640 fbm

$\left(\frac{(2")(4")}{12\ in/ft}\right)$ (16') (40 boards) = 426 2/3 fbm

$\left(\frac{(2")(8")}{12\ in/ft}\right)$ (10') (20 boards) = 266 2/3 fbm

$\left(\frac{(2")(12")}{12\ ft/in}\right)$ (12') (20 boards) = 480 fbm

$\left(\frac{(3")(6')}{12\ in/ft}\right)$ (10') (30 boards) = 450 fbm

$\left(\frac{(4')(8')}{12\ in/ft}\right)$ (16') (40 boards) = 1706 2/3 fbm

$\left(\frac{(6")(10")}{12\ in/ft}\right)$ (18') (60 boards) = 5400 fbm

$\left(\frac{(8")(8")}{12\ in/ft}\right)$ (16') (10 boards) = 853 1/3 fbm

A. Problem with Complete Solution

1. A machine shop is contracted to lathe 36 drill blanks. Each drill blank requires a piece of rough material 5 3/4" long. How many feet of rough material are needed?

Solution:

Need the product of number of blanks and length of material, then divide by 12 to convert to feet.

$$\text{Length of stock} = \frac{(36 \text{ blanks})(5\ 3/4 \text{ in/blank})}{12 \text{ in/ft}}$$

$$= 17\ 1/4 \text{ ft}$$

B. Problems without Complete Solutions

2. What is the difference between the thicknesses of the ends of the key?

Solution:

3. In a metal bench work class of 42 boys, each is allowed 7 1/2" of wire solder for his work. How many feet of wire solder does the class use?

Solution:

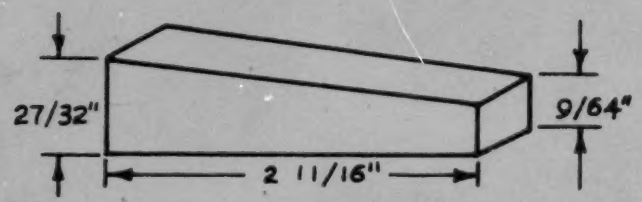
B. Problems without Complete Solutions (continued)

4. A machine shop has a job which requires drilling 3 holes for a fixture. The distance from the center line (℄) of the first hole to the ℄ of the second is 12 11/16". The distance from the ℄ of the second hole to the ℄ of the third is 9 5/8". The distances from the center lines of the first and third holes to the ends of the fixture are both 12 11/16". What length of stock is needed for the job?

   Solution:

5. A Machinist is making a square detail for a jig. The allowed over all distance on the jig is 9 5/8". If 8 teeth are to be cut, how far apart are the teeth?

   Solution:



6. In metal bench work a machinist is to tap two holes 1 1/16" apart in a cast iron "T" block. One hole is 3/8 x 16 N.C. and the other hole is 1/2 x 13 N.C. The "T" block is 2 5/8" long. How far from the edge is the ℄ of each tapped hole?

   Def: 3/8" -- diameter of bolt or thread
   16 -- number of threads per inch
   N.C. -- National Course

   Solution:

Complete Solutions to B problems

2. Need to subtract the low end from the high end.

$$\text{End difference} = \frac{27"}{32} - \frac{9"}{64} = \frac{54"}{64} - \frac{9"}{64} = \frac{45}{64} \text{ in}$$

3. Need to multiply number of boys times the length of solder issued to each boy and then divide by 12 to find total number of feet.

$$\text{Total length of solder} = \frac{(42 \text{ boys})(7\ 1/2 \text{ in/boy})}{12 \text{ in/ft}}$$

$$= \frac{315 \text{ ft}}{12} = 26\ 1/4 \text{ ft}$$

4. Need sum of distances between center line and twice distance from ℄ of first and third hole to edge.

$$\text{Length of stock} = 3(12\ 11/16 \text{ in}) + 9\ 5/8 \text{ in}$$

$$= 38\ 1/16 \text{ in} + 9\ 10/16 \text{ in}$$

$$= 47\ 11/16 \text{ in}$$

5. Need to divide the overall distance of the jig by the number of teeth.

$$\text{Distance between teeth} = \frac{9\ 5/8"}{8 \text{ teeth}} = \frac{77/8 \text{ in}}{8 \text{ teeth}}$$

$$= \frac{77}{64} \text{ in/teeth} = 1\ 13/64 \text{ inches per tooth}$$

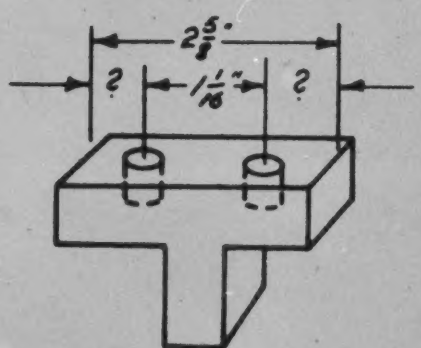
6. If we center the two holes, find difference between total length and distance between centers. Find 1/2 of that difference, and you have distance from each edge to center line.

$$\text{Distance edge to ℄} = \frac{2\ 5/8" - 1\ 1/16"}{2}$$

$$= \frac{1\ 9/16 \text{ in}}{2}$$

$$= \frac{25/16 \text{ in}}{2}$$

$$= \frac{25}{32} \text{ in}$$



A. Problems with Solutions

1. A 12" piece of shafting 1 5/8" in diameter is placed in a lathe, and one end is turned down to a diameter of 1 1/32". The diameter of the small end is how much smaller than the diameter of the large end?

   Solution:

   1 5/8" - 1 1/32" = 1 20/32" - 1 1 /32" = 19/32 in

2. A piece of shafting 11 5/32" long is cut from a piece 37 1/2" long. Will there be enough of the original piece left to make another piece 26 1/4" long if 1/16" of shafting was wasted in making the cut?

   Solution:

   Length left = 37 1/2" - 11 5/32" - 1/16"

   = 37 16/32" - 11 5/32" - 2/32"

   = 26 9/32 in

   Yes, since 26 9/32 in is greater than 26 1/4 in

3. From a bar of brass 16 1/2" long the following three pieces are cut: 1 1/8", 3 1/2", and 3 5/32". What is the final length of the bar allowing 3/32" for each cut?

   Solution:

   16 1/2" - 1 1/8" - 3 1/2" - 3 5/32" - 3(3/32") =

   16 16/32" - 1 4/32" - 3 16/32" - 3 5/32" - 9/32" =

   16 16/32" - 7 34/32" = 16 16/32" - 8 2/32" = 8 14/32"

   = 8 7/16 in

B. Problems without Solutions

4. The volume of a rectangular box is found by multiplying the length times the width times the height. What is the volume of a rectangular box if its dimensions are 15 1/4", 12 1/2" and 7 5/32"?

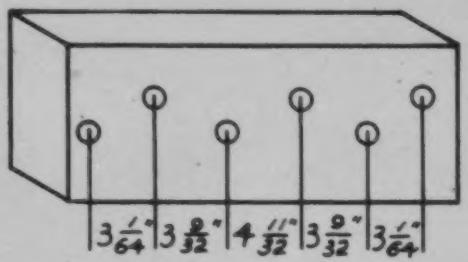
5. To find the approximate circumference of a circle, we multiply 3 1/7 by the diameter. What is the approximate circumference of a circle whose diameter is 49 1/2"?

6. A cubic foot contains approximately 7 1/2 gallons. How many cubic feet are there in a tank which contains 72 1/4 gallons?

7. How many holes spaced 1 7/16" center to center can be drilled in a piece of angle iron 22 5/8" long, allowing 1 1/4" on each end?

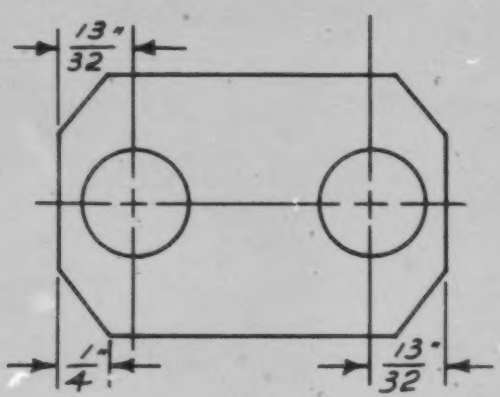
B. Problems without Solutions (continued)

8. Find the distance between the end holes in the plate pictured.



9. How long will it take to machine 25 pins if each pin takes 10 1/2 minutes? Allow 1 1/2 minutes per pin for placing stock in the lathe and putting away the finished pin.

10. A series of links are to be made like the one illustrated with all measurements the same except for the center to center distance between the holes. Find the length of stock used for each link if 3/16" is allowed for sawing and finishing the ends in each case. The center to center distances are as follows: (a) 1 53/64", (b) 1 7/16" and (c) 1 13/64".



B. Problems without Solutions (continued)

11. An order of 31 bars of steel were delivered to a machine shop. Each bar was 19' 7 4/32" long. Find the total linear feet in the order.

Complete Solutions to B Problems

4. $\text{Volume} = \left(15\ \frac{1}{4}"\right)\left(12\ \frac{1}{2}"\right)\left(7\ \frac{5}{32}"\right)$

$= \left(\frac{61}{4}"\right)\left(\frac{25}{2}"\right)\left(\frac{229}{32}"\right)$

$= \frac{349{,}225}{256}$ cu in

$= 1{,}364$ cu in

5. $\text{Circumference} = \left(3\ \frac{1}{7}\right)\left(49\ \frac{1}{2}"\right) = \left(\frac{22}{7}\right)\left(\frac{99}{2}"\right) = \frac{2178}{14}"$ = about 156 in

6. $\frac{72\ \frac{1}{4}\ \text{gals}}{7\ \frac{1}{2}\ \text{gals/cu ft}} = \frac{\left(\frac{289}{4}\ \cancel{\text{gals}}\right)(\text{cu ft})}{\frac{15}{2}\ \cancel{\text{gals}}} = \left(\frac{289}{4}\ \text{cu ft}\right)\left(\frac{2}{15}\right)$

$= \frac{578}{60}$ cu ft or about $9\ \frac{1}{2}$ cu ft

7. $\text{number of holes} = \frac{22\ \frac{5}{8}" - 2\left(1\ \frac{1}{4}"\right)}{1\ \frac{7}{16}"} = \frac{22\ \frac{5}{8}" - 2\ \frac{1}{2}"}{1\ \frac{7}{16}"}$

$= \frac{20\ \frac{1}{8}"}{1\ \frac{7}{16}"} = \frac{\frac{161}{8}\ \cancel{\text{in}}}{\frac{23}{16}\ \cancel{\text{in}}}$

$= \left(\frac{161}{8}\right)\left(\frac{16}{23}\right) = \frac{2576}{184} = 14$

8. $\text{Distance} = 3\ \frac{1}{64}" + 3\ \frac{9}{32}" + 4\ \frac{11}{32}" + 3\ \frac{9}{32}" + 3\ \frac{1}{64}"$

$= 3\ \frac{1}{64}" + 3\ \frac{18}{64}" + 4\ \frac{22}{64}" + 3\ \frac{18}{64}" + 3\ \frac{1}{64}"$

$= 16\ \frac{60}{64}" = 16\ \frac{15}{16}$ in

Complete Solutions to B Problems (continued)

9. $(25\ \cancel{\text{pins}})\left(10\ \frac{1}{2}\ \frac{\text{min}}{\cancel{\text{pin}}}\right) + (25\ \cancel{\text{pins}})\left(1\ \frac{1}{2}\ \frac{\text{min}}{\cancel{\text{pin}}}\right) = 250\ \frac{25}{2}\ \text{min} + 25\ \frac{25}{2}\ \text{min}$

$= 275\ \frac{50}{2}\ \text{min} = 300\ \text{min}$

10. (a) $1\ \frac{53"}{64} + 2\left(\frac{13"}{32}\right) + \left(\frac{3"}{16}\right) = 1\ \frac{53"}{64} + \frac{52"}{64} + \frac{12"}{64} = 1\ \frac{117"}{64} = 2\ \frac{53}{64}\ \text{in}$

(b) $1\ \frac{7"}{16} + 2\left(\frac{13"}{32}\right) + \frac{3"}{16} = 1\ \frac{14"}{32} + \frac{26"}{32} + \frac{6"}{32} = 1\ \frac{46"}{32}$

$= 2\ \frac{7}{16}\ \text{in}$

(c) $1\ \frac{13"}{64} + 2\left(\frac{13"}{32}\right) + \frac{3"}{16} = 1\ \frac{13"}{64} + \frac{52"}{64} + \frac{12"}{64} = 1\ \frac{77"}{64}$

$= 2\ \frac{13}{64}\ \text{in}$

11. $\text{Length} = (31)\left(19'\ 7\ \frac{4"}{32}\right) = 589'\ 217\ \frac{124"}{32}$

$= 589'\ 220\ \frac{28"}{32}$

$= 607'\ 4\ \frac{28"}{32} = 607\ \text{ft}\ 4\ \frac{7}{8}\ \text{in}$

A. Problems with solutions.

1. Work the following problems:
   a) 5/8 - 1/4 = _____
   b) (2) (1/2) = _____
   c) $\frac{1/2}{1/4}$ = _____

Solution :

a) Find a common denominator.
8 will work, so, change 1/4 into eighths.

$$\left(\frac{2}{2}\right)\left(\frac{1}{4}\right) = \frac{2}{8}$$

5/8 - 2/8 = 3/8

b) (2/1)(1/2) = 2/2 = 1

c) $\frac{1/2}{1/4}$ = (1/2) (4/1) = 4/2 = 2

2. Reduce the answers:
   a) 1/2 - 1/3 = _____
   b) (17 1/8)(5 1/2) = _____
   c) $\frac{\frac{1}{100}}{\frac{1}{150}}$ = _____

Solution : a) Find a common denominator
6 will work, so, change 1/2 and 1/3 into sixths

(1/2)(3/3) = 3/6

(1/3)(2/2) = 2/6

3/6 - 2/6 = 1/6

b) Change both numbers into eighths.

$$\left(\frac{17}{1}\right)\left(\frac{8}{8}\right) = \frac{136}{8} + \frac{1}{8} = \frac{137}{8}$$

$$\left(\frac{5}{1}\right)\left(\frac{8}{8}\right) = \frac{40}{8} + \frac{3}{8} = \frac{43}{8}$$

A. Problems with solutions.

2. continued. $\left(\frac{137}{8}\right)\left(\frac{43}{8}\right) = \frac{5,891}{64}$

c) $\dfrac{\frac{1}{100}}{\frac{1}{150}} = \left(\frac{1}{100}\right)\left(\frac{150}{1}\right) = \frac{150}{100} = 1.50$

B. Problems without solutions.

3. The label reads Morphine gr 1/8. How many tablets would be needed to give Morphine gr 1/4?

4. a) (5/6)(4/5) = b) (4/5)(15/16) = c) (6/7)(7/12) =

d) (2/5)(5/8) = e) (2/3)(1 1/2) = f) (1/6)(12) =

g) (24)(5/6) = h) (14)(6/7) = i) (9 1/3)(1/3) =

j) (64)(5/8) =

B. Problems without solutions.

5. a) 2/3 ÷ 1/2 = b) 1/3 ÷ 1/6 = c) 1/3 ÷ 1/8 =

   d) 8/9 ÷ 1/18 = e) 1/6 ÷ 1/8 = f) 3/8 ÷ 1/4 =

   g) 3 ÷ 1/3 = h) 6 7/9 ÷ 1/36 = i) 9 ÷ 2/3 =

   j) 1 4/5 ÷ 3/20 =

6. Reduce to the lowest terms:

   a) 100/150 =
   b) 72/144 =

7. a) 3/4 - 1/3
   b) 4 1/8 ÷ 15/16

8. Reduce the answers of thef following.

   a) 16
      -7 3/4

   b) 5 7/8
      2 3/4
      + 1/2

B. Problems without solutions.

9. Arrange the following in the order of size, from smallest to largest:

1/2, 5/8, 11/12, 1, 5/64, 3/4, 1/6, and 1/9.

10. Arrange the following fractions according to size, beginning with the smallest.

1/2, 1/5, 2/3, 7/8, 1/150, 3/1000, 1/3.

Complete solutions to B problems.

3. $\frac{1/4 \text{ gr}}{\frac{1/8 \text{ gr}}{\text{tablet}}}$ = (1/4 gr)(8/1 tablet/gr) = 8/4 tablets = 2 tablets

4. a. (5/6)(4/5) = 20/30 = 2/3

b. (4/5)(15/16 = 60/80 = 3/4

c. (6/7)(7/12) = 42/84 = 1/2

d. (2/5)(5/8) = 10/40 = 1/4

e. (2/3)(3/2) = 6/6 = 1

f. (1/6)(12/1) = 12/6 = 2

g. (24/1)(5/6) = 120/6 = 20

h. (14/1)(6/7) = 84/7 = 12

i. (28/3)(1/3) = 28/9 = 3 1/9

J. (64/1) (5/8) = 320/8 = 40

5. a. $\frac{\frac{2}{3}}{1/2}$ = (2/3)(2/1) = 4/3

b. $\frac{1/3}{1/6}$ = (1/3)(6/1) = 6/3 = 2

c. $\frac{1/3}{1/8}$ = (1/3)(8/1) = 8/3

d. $\frac{8/9}{1/18}$ = (8/9)(18/1) = 144/9 = 16

e. $\frac{1/6}{1/8}$ = (1/6)(8/1) = 8/6 = 4/3

f. $\frac{3/8}{1/4}$ = (3/8)(4/1) = 12/8 = 3/2

g. $\frac{3/1}{1/3}$ = (3/1)(3/1) = 9/1 = 9

h. $\frac{61/9}{1/36}$ = (61/9)(36/1) = $\frac{2196}{9}$ = 244

i. $\frac{9/1}{2/3}$ = (9/1)(3/2) = 27/2 = 13.5

j. $\frac{9/5}{3/20}$ = (9/5)(20/3) = $\frac{180}{15}$ = 12

6. $\frac{100}{150} = \frac{10}{15} = \frac{2}{3}$

$\frac{72}{144} = \frac{36}{72} = \frac{18}{36} = \frac{9}{18} = \frac{3}{6} = \frac{1}{2}$

7. Find a common denominator, 12 will work, so, convert 3/4 and 1/3 to twelveths.

(3/4)(3/3) = 9/12

(1/3)(4/4) = 4/12

9/12 - 4/12 = 5/12

Complete solutions to 8 problems.

7. continued.

b) $\frac{33/8}{15/16} = (33/8)(16/15) = 528/120$

8. a) $16 = 64/4$

$7\ 3/4 = 31/4$

$64/4 - 31/4 = 33/4 = 8\ 1/4$

b) $5\ 7/8 = 47/8$

$2\ 3/4 = 11/4 = 22/8$

$1/2 = 4/8$

$47/8 + 22/8 + 4/8 = 73/8$

9. The lowest common denominator is 576, so convert each fraction to five hundred seventy sixths:

$1/2 = 288/576$ $\quad 1 = 576/576$ $\quad 1/6 = 96/576$

$5/8 = 360/576$ $\quad 5/64 = 45/576$ $\quad 1/9 = 64/576$

$11/12 = 528/576$ $\quad 3/4 = 432/576$

The correct order is 5/64, 1/9, 1/6, 1/2, 5/8, 3/4, 11/12, 1

10. The lowest common denominator is 3,000, so change every fraction to three thousandths.

$1/2 = \frac{1,500}{3,000}$ $\quad 1/150 = \frac{20}{3,000}$

$1/5 = \frac{600}{3,000}$ $\quad 3/3000 = \frac{9}{3000}$

$2/3 = \frac{2000}{3000}$ $\quad 1/3 = \frac{1000}{3000}$

$7/8 = \frac{2625}{3000}$

The correct order is, 3/1000, 1/150, 1/5, 1/3, 1/2, 2/3, 7/8.

A. Problems with Solutions

1. One of the concerns at the sawmill is in determining the thickness which to cut the logs to produce a finished product of a certain size. If the planers will remove $\frac{1}{32}$ of an inch in thickness and shrinkage from the green size will account for another $\frac{1}{8}$ inch what will the original thickness of the board need to be to have a finished product of thickness

a) $\frac{25"}{32}$

b) $1\frac{5}{8}"$

c) $\frac{7"}{16}$

Solution:

a) $\frac{25"}{32} + \frac{1"}{32} + \frac{1"}{8} = \frac{25"}{32} + \frac{1"}{32} + \frac{4"}{32} = \frac{30"}{32} = \frac{15"}{16}$

b) $1\frac{5"}{8} + \frac{1"}{32} + \frac{1"}{8} = \frac{13"}{8} + \frac{1"}{32} + \frac{1"}{8} = \frac{52"}{32} + \frac{1"}{32} + \frac{4"}{32}$

$= \frac{57"}{32}$

$= 1\frac{25"}{32}$

c) $\frac{7"}{16} + \frac{1"}{32} + \frac{1"}{8} = \frac{14"}{32} + \frac{1"}{32} + \frac{4"}{32} = \frac{19"}{32}$

2. Normal 2" lumber now has an actual thickness of $1\frac{5"}{8}$. It is being proposed that this be reduced to $1\frac{1"}{2}$ thickness.

a) What is the actual reduction in thickness which is being proposed?

Solution:

a) $1\frac{5"}{8} - 1\frac{1"}{2} = 1\frac{5"}{8} - 1\frac{4"}{8} = \frac{1"}{8}$

B. Problems without Solutions

3. Nominal 1" (inch) lumber now has an actual thickness of $\frac{25"}{32}$. It is being proposed that this be reduced to $\frac{3"}{4}$.

   a) What is the actual reduction in thickness which is being proposed?

4. A wood products company is experimenting with reducing their 8 ply laminated beams to 7 ply without changing the overall dimensions. This would amount to a significant reduction in the amount of glue needed to produce the beam. State the thickness for each ply first in 8 ply and then in 7 ply laminated beams whose overall thickness is to be

   a) 14"

   b) 16"

5. The pine products industry usually describes the thickness of its products in "quarters" or 1/4 inch specifications. Thus a board which is 1 inch in thickness would be described as a four quarter board. How would the pine industry describe boards of the following thickness?

   a) $\frac{3}{4}$ in.

   b) $\frac{1}{2}$ in.

   c) $1\frac{1}{4}$ in.

   d) 3 in.

   e) $2\frac{1}{2}$ in.

B. Problems without solutions, continued.

6. A stand of douglas fir shows the average height to be 30 feet at an average of 12 years, and the average DBH is 4 inches. (DBH means diameter of the tree at a distance above the ground as high as a man's chest.)

   There are 800 acres in the area and 218 trees/acre. At age 30 a cordwood thinning is done, taking out half the trees. The harvest will be at age 60 and will be clear cut.

   a) What is the average annual ht growth and DBH growth?
   b) What is the average height and DBH at time of thinning?
   c) How many cords of wood will be harvested at 30 years, if we can expect $\frac{1}{5}$ cord per tree?
   d) What will be the average height and DBH at final harvest?
   e) What will be the volume at final harvest assuming 620 Bd-Ft/tree?

Solutions

3. Solution: a) $\frac{25"}{32} - \frac{3"}{4} = \frac{25"}{32} - \frac{24"}{32} = \frac{1"}{32}$

4. Solution: a) 8 ply $\frac{14"}{8} = 1\frac{6"}{8} = 1\frac{3"}{4}$

7 ply $\frac{14"}{7} = 2"$

b) 8 ply $\frac{16"}{8} = 2"$

7 ply $\frac{16"}{7} = 2\frac{2"}{7}$

5. Solution: a) $\frac{3"}{4}$ = (3) (1/4 in.) = 3 quarters

b) $\frac{1"}{2} = \frac{2"}{4}$ = (2) (1/4 in.) = 2 quarters

c) $1\frac{1"}{4} = \frac{5}{4}$ = (5) (1/4 in.) = 5 quarters

d) $3" = \frac{12"}{4}$ = (12) (1/4) = 12 quarters

e) $2\frac{1"}{2} = \frac{5"}{2} = \frac{10"}{4}$ = (10) (1/4 in.) = 10 quarters

Complete Solutions to B Problems (continued)

6. a) $\frac{30 \text{ ft}}{12 \text{ yrs}} = 2\frac{1}{2}$ ft/yr $\qquad \frac{4 \text{ in}}{12 \text{ yrs}} = \frac{1}{3}$ in/yr

b) (30 yr)(2 1/2 ft/yr) = 75 ft height

(30 yr)(1/3 in/yr) = 10 in DBH

c) (1/5 cord/tree)(109 trees/acre)(800 acres) = 17,440 cords

d) (60 yrs)(2 1/2 ft/yr) = 150 ft height

(60 yrs)(1/3 in/yr) = 20 in DBH

e) (109 trees/acre)(800 acres)(620 bd-ft/tree) = 54,064,000 bd-ft

A. Problems with solutions.

1. Compute the number of board feet in 18 boards which are 2" x 8" x 16' long. Use the formula:

$$\text{Board feet} = \frac{\left(\begin{matrix}\text{No. of}\\ \text{boards}\end{matrix}\right)\left(\begin{matrix}\text{thickness}\\ \text{in inches}\end{matrix}\right)\left(\begin{matrix}\text{width in}\\ \text{inches}\end{matrix}\right)\left(\begin{matrix}\text{length in}\\ \text{feet}\end{matrix}\right)}{12}$$

Solution:

$$\frac{(18)(2")(8")\ (16')}{12} = 384 \text{ board feet}$$

2. An electric cream separator requires 1/2 kilowatt-hour of energy per 1000 lbs of milk processed. At 3 1/4¢ per kwhr, find the monthly (30 day) cost of electrical energy for this operation on a farm where an average of 1,840 lbs of milk is run through the separator per day.

Solution:

$$\left(\frac{1/2 \text{ kwhr}}{1000 \text{ lbs}}\right)\left(\frac{1840 \text{ lbs}}{\text{day}}\right)\left(\frac{30 \text{ days}}{\text{month}}\right)\left(\frac{3\ 1/4¢}{\text{kwhr}}\right) =$$

$$\left(\frac{1}{2000}\right)(1840)\ (30)\ (\$0.0325)\left(\frac{¢}{\text{month}}\right) = 89\ 7/10¢ \text{ or } 90¢/\text{month}$$

3. A 24 1/2 lb strip of bacon was bought at 56¢ a pound and sold sliced, without rind, at 98¢ a pound. What was the profit if the weight of the rind was 1/7 the weight of the strip?

Solution:

$$\text{rind} = \left(\frac{1}{7}\right)\left(24\ \frac{1}{2}\text{ lb}\right) = \left(\frac{1}{7}\right)\left(\frac{49 \text{ lbs}}{2}\right) = 3\ \frac{1}{2} \text{ lbs.}$$

$$\text{weight of bacon} = 24\ \frac{1}{2} - 3\ \frac{1}{2} = 21 \text{ lbs}$$

$$\text{cost of strip} = \left(24\frac{1}{2}\right)(.56) = \left(\frac{49}{2}\right)(.56) = \$13.72$$

$$\text{Selling price} = (21)\ (.98) = \$20.58$$

$$\text{profit} \quad \$20.58 - 13.72 = \$6.86$$

4. An uncultivated fence line 4 1/8 feet wide and one mile long provides what fraction of an acre of wildlife cover?

Solution: $(1 \text{ mile})\left(\frac{5280 \text{ ft}}{1 \text{ mile}}\right)(4\ 1/8 \text{ ft}) = (5280 \text{ ft})\left(\frac{33 \text{ ft}}{8}\right) =$

$$(21780 \text{ ft}^2)\left(\frac{1 \text{ acre}}{43560 \text{ ft}^2}\right) = 1/2 \text{ acre}$$

B. Problems without solutions.

5. Compute the number of board feet in the following order.

10 (1")(8") - 12'

24 (2")(4") - 16'

8 (2")(8") - 12'

2 (4")(6") - 8'

6. It is estimated that 13 1/4 kwhr of electricity are required to incubate 100 eggs. At 3 3/8¢ per kilowatt-hour find the cost of the energy required to incubate the 100 eggs.

7. Assuming that skim milk used for feeding purposes is worth half as much per 100 lbs as corn is per bushel, what should be the value of 1,600 lbs of skim milk when corn is worth $2.89 per bushel?

8. A forage frame which is one four-thousandths of an acre in size measures 3 feet in width by how many feet in length?

B. Problems without solutions, continued.

9. A 150 ft roll of 60-inch poultry fencing of a name-brand weighs 53 1/3 lbs. Estimate the total number of feet of fencing contained in 4 partially used rolls weighing 27 1/4 lbs., 19 1/2 lbs., 8 lbs., and 34 3/4 lbs.

10. What fraction of an acre is a plot of ground 653 1/3 feet long and 3 1/3 feet wide (40-inch row width)?

11. Under range conditions 21 1/2 pounds of salt are needed for each cow during a year. Each calf needs 3/7 as much as a cow. If you have a herd of 1,214 cows with calves and 714 cows without calves, how much would salt cost for a year, if you can buy it at $12 2/3 per ton?

B. Problems without solutions, continued.

12. The outside dimension of a field are 1/5 mile by 3/4 mile. You make 5 trips around the field with an outfit 25 3/4 ft wide. How many acres have you covered? Assume no overlap.

13. A leghorn laying hen requires about 35 lbs mash costing $7.80 per hundred weight and 50 lbs of grain costing $6.00 per hundred weight each year. If labor costs are estimated to be 1/3 as much as the feed cost and assuming that the owner will receive 60¢ per dozen for the eggs, what should the average annual production of eggs be in order for a flock of 10,000 birds to yield a gross profit equal to 1/4 of the owners investment in feed and labor?

B. Problems without Solutions (continued)

14. One form of accelerating depreciation is the sum-of-the-years-digits method. Annual depreciation is determined by multiplying a calculated fraction times the original cost minus salvage value. (The calculated fraction is determined by adding the number of useful years for the denominator and considering the number of years remaining for depreciation as the numerator.) Find the annual depreciation using a $20,500 tractor with 10 year life and a $2,500 salvage value.

Complete solutions to B Problems

5. $\frac{(10)(1")(8")(12')}{12}$ = 80 board ft

$\frac{(24)(2")(4")(16')}{12}$ = 256 board ft

$\frac{(8)(2")(8")(12')}{12}$ = 128 board ft

$\frac{(2)(4")(6")(8')}{12}$ = 32 board ft

Total 496 board ft

6. (13 1/4 ~~kwhr~~)(3 3/8¢/~~kwhr~~) = (53/4)(27/8¢)
= 1431/32¢
= 44 23/32¢
= $0.45

7. (1/2)($2.89/hundred lbs) = ($1.445/~~hundred lbs~~)(16 ~~hundred lbs~~)
= $23.12

8. 1 acre = 43,560 sq ft

(43,560 sq ft/~~acre~~)(1/4000 ~~acre~~) = 10 3560/4000 sq ft
= 10 89/100 sq ft

$\frac{10\ 89/100\ \text{sq ft}}{3\ \text{ft}} = \frac{1089/100\ \text{ft}}{3}$ = 1089/300 ft = 3 63/100 ft

9. Total weight = 27 1/4 lbs + 19 1/2 lbs + 8 lbs + 34 3/4 lbs +
27 1/4 lbs + 19 2/4 lbs + 8 lbs + 34 3/4 lbs
= 88 6/4 lbs
= 89 1/2 lbs

$\frac{89\ 1/2\ \text{lbs}}{53\ 1/3\ \text{lbs/roll}} = \frac{179/2\ \text{rolls}}{160/3\ \text{rolls}}$ = 537/320 rolls

(537/320 ~~rolls~~)(150 ft/~~roll~~) = 251 23/32 ft = 250 ft

10. (653 1/3 ft)(3 1/3 ft) = (1960/3 ft)(10/3 ft) = 19600/9 sq ft

(19600/9 ~~sq ft~~)(1 acre/43,560 ~~sq ft~~) = 1/20 acre

Complete Solutions to B Problems (continued)

11. Cows = 1214 + 714 = 1,928

Calves = 1214

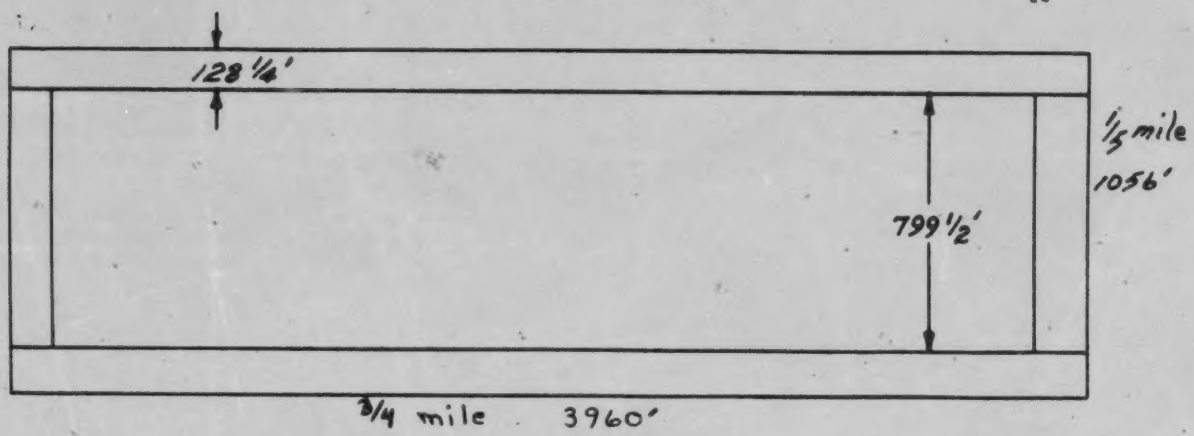
(1,928 cows)(21 1/2 lb/cow) + (1,214 calves)(3/7)(21 1/2 lb/calf) =

(1,928)(43/2 lbs) + (1,214)(3/7)(43/2 lbs) = 41,452 lbs + 11,186 1/7 lbs =

52,638 1/7 lbs

Convert to tons

(52,638 1/7 lbs)(1 ton/2,000 lbs)($12 2/3/ton) = $333.37



(25 3/4')(5) = (103/4 ft)(5) = 513/4 ft = 128 1/4 ft

1056' - 2(128 1/4') = 1056' - 256 1/2' = 799 1/2 ft

Acre = 2(3960 ft)(128 1/4 ft) + 2(799 1/2 ft)(128 1/4 ft)
= (2)(3960 ft)(513/4 ft) + (2)(1599/2 ft)(513/4 ft)
= 1,015,740 sq ft + 205,071 3/4 sq ft
= (1,220,819 3/4 sq ft)(1 acre/43,560 sq ft)
= 28 acres

13. Mash: (35 lbs/hen)($7.80/100-lbs) = $2.73 per hen

Grain: (50 lbs/hen)($6.00/100-lbs) = $3.00 per hen

Total feed = ($2.73/hen + $3.00/hen)(10,000 hens)
= ($5.73/hen)(10,000 hens)
= $57,300

Labor = (1/3)($57,300) = $19,100

Complete Solutions to B Problems (continued)

13. Feed + Labor = $57,300 + $19,100 = $76,400

Gross profit = (1/4)($76,400) = $19,100

Total to be made = $76,400 + $19,100 = $95,500

$$\frac{\$95{,}500}{\$0.60/\text{doz}} = 159{,}167 \text{ dozen}$$

14. Sum of years = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = 55

Annual Depreciation	Remaining Balance
(10/55)($20,500 - $2,500) = $3,272.73	$17,227.27
(9/55)($20,500 - $2,500) = $2,945.46	$14,281.81
(8/55)($20,500 - $2,500) = $2,618.19	$11,663.62
(7/55)($20,500 - $2,500) = $2,290.91	$9,372.71
(6/55)($20,500 - $2,500) = $1,963.64	$7,409.07
(5/55)($20,500 - $2,500) = $1,636.37	$5,772.70
(4/55)($20,500 - $2,500) = $1,309.09	$4,463.61
(3/55)($20,500 - $2,500) = $981.82	$3,481.79
(2/55)($20,500 - $2,500) = $654.55	$2,827.24
(1/55)($20,500 - $2,500) = $327.24	$2,500.00

A. Problems with Solutions

1. A radio motor patrol car finds it necessary to travel at 90 miles per hour for a period of 1 minute and 40 seconds. How many miles will the car travel during this period?

Solution:

You need to find what fraction of an hour 1 minute 40 seconds is.

1 min 40 sec = 1 40/60 = 1 2/3 min

$1\ 2/3 \text{ min} = \frac{1\ 2/3}{60} \text{ hrs} = \frac{5/3}{60} \text{ hrs}$

$= \frac{5/3}{60/1} = (5/3)(1/60)$

$= 5/180 = 1/36$ hrs

Distance = (rate)(time)

= (90 miles/hour)(1/36 hrs)

= 90/36 miles = 2 1/2 miles

2. A storage tank of water used to fight summer fires contains 22,494 gallons of water. This tank can be emptied by a pump at the rate of 624 5/6 gallons per minute. What part of an hour will be required to empty the tank?

Solution:

You need to divide the number of gallons by the rate of flow to find how many minutes it will take to empty the tank.

$\text{Number of minutes} = \frac{\text{number of gallons}}{\text{rate of flow}}$

$= \frac{22{,}494 \text{ gallons}}{624\ 5/6 \text{ gal/minute}}$

$= \frac{22{,}494 \text{ gallons}}{3749 \text{ gal}/6 \text{ min}} = (22{,}494)\left(\frac{6 \text{ minutes}}{3{,}749}\right)$

$= \frac{134{,}964 \text{ minutes}}{3{,}749}$

= 36 minutes

Now find what part of an hour is 36 minutes.

36 minutes = 36/60 hr = 6/10 hr So it takes 6/10 of an hour to empty the tank

A. Problems with Solutions (continued)

3. A city pumping station can pump 3,600,000 gallons of water in 24 hours. The pump is operated on an average of 14 hours a day. The population of the city is 15,000. What is the average number of gallons of water pumped every day for each resident of the city?

Solution:

Since the pump is operated an average of 14 hours a day, it is running 14/24 or 7/12 of a day. We need to find 7/12 of the total gallons that can be pumped in one 24 hour period.

7/12 of 3,600,000 gallons = (7/12)(3,600,000 gallons/1)

= 25,200,000/12 gallons

= 2,100,000 gallons

To find the number of gallons pumped each day per resident, we need to divide the number of gallons by the number of people in the city.

$$\text{gallons per resident} = \frac{2{,}100{,}000 \text{ gals}}{15{,}000 \text{ residents}}$$

= 140 gallons/resident

B. Problems without Solutions

4. The record of pumper truck number 4 at the end of the month shows that it made 14 runs. The mileage report on the 14 runs is as follows: 8 3/10, 6 1/10, 12 5/10, 16 2/10, 17 4/10, 13 9/10, 8 1/10, 19, 20 2/10, 18 7/10, 14 1/10, 8/10, 22 7/10, and 17 7/10. What is the total mileage on runs for the month? The total mileage recorded on the odometer was 234 3/10. How many miles were recorded while the truck was not on a run?

B. Problems without Solutions (continued)

5. The total distance it takes to stop a car is the distance traveled while the driver changes his foot to the brake and then the distance after the brake is engaged. For a car going at 60 mph the distance traveled while the driver changes his foot to the brake is 82 3/8 feet and the braking distance is 263 1/4 feet. What is the total distance traveled?

6. The water pressure in the water main is 65 2/3 lbs/in . If during a bad fire the pressure is reduced to 4/7 of the original pressure, what would be the reduced pressure?

7. In many American police departments the line power of the departments particularly the patrol force is divided into three platoon shifts as follows:

   1st - 8:00 a.m. to 4:00 p.m. - 1/7 force

   2nd - 4:00 p.m. to 12 midnight - 4/7 force

   3rd - 12 midnight to 8:00 a.m. - 2/7 force

   How many would be on each platoon in a force of 133 patrolmen?

B. Problems without Solutions (continued)

8. The police department had received 19/21 of their total budget and had spent 7/12 of their total budget. What fraction of the total budget is still available?

9. The "pitch" of rifling is a measure of the twisting of the land and grooves. If a bullet is fired through a rifle with a pitch of one turn for each 12 1/2 inches, how many turns would it make if the rifle barrel is 26 1/2 inches long?

10. A gallon of water weighs approximately 8 3/8 pounds. What weight is added to the gross weight of the booster truck if the tank will hold 843 gallons when filled? According to the restrictions, the tank can add only 2 ton of weight when the booster truck is going to a field fire. How many gallons could the crew put into the tank and still follow regulations? (2,000 lb = 1 ton)

Complete Solutions to B Problems

4. You need to total the amounts recorded on the 14 runs, and then subtract this total from the odometer reading to find the number of miles accumulated while not on official runs.

8 3/10 + 6 1/10 + 12 5/10 + 16 2/10 + 17 4/10 + 13 9/10 + 8 1/10

+ 19 + 20 2/10 + 18 7/10 + 14 1/10 + 8/10 + 22 7/10 + 17 7/10 =

190 57/10 = 195 7/10 miles on 14 official runs

234 3/10 - 195 7/10 = 233 13/10 - 195 7/10 = 38 6/10 miles on unofficial runs.

5. You need to add the two distances together

263 1/4 ft + 82 3/8 ft = 263 2/8 ft + 82 3/8 ft

= 345 5/8 ft

So total distance traveled is 345 5/8 feet

6. You need to find 4/7 of 63 2/3 lbs/sq in

(4/7)(65 2/3) = (4/7)(197/3)

= 788/21 = 37 11/21

So reduced pressure is 37 11/21 lbs/sq in

7. You need to find how many times 7 goes into 133, and then multiply it by 1 for the first shift, 4 for the second shift, and 2 for the third shift

(1/7)(133/1) = 133/7 = 19

For the first shift, (1)(19) = 19 men
For the second shift (4)(19) = 76 men
For the third shift, (2) (19) = 38 men

8. You need to compute the difference between the fractional part of the budget received and the fractional part spent.

19/21 - 7/12 = 76/84 - 49/84 = 27/84 = 9/28 of the total budget still available

Complete Solutions to B Problems (continued)

9. You need to find how many times 12 1/2 inches goes into 26 1/2 inches

$$\frac{26\ 1/2 \text{ inches}}{12\ 1/2 \text{ inches}} = \frac{53/2 \text{ inches}}{25/2 \text{ inches}} = \frac{106}{50} = 2\ 6/50 \text{ or } 2\ 3/25$$

So the bullet would make 2 3/25 turns

10. First we need to multiply the weight of one gallon of water by the capacity of the truck.

$$(843 \text{ gallons})(8\ 3/8 \text{ lbs/gallon}) = (843)(67/8)$$
$$= 7060\ 1/8 \text{ lbs}$$

We can take only 2 tons (or 4000 lbs), so we need to find the difference between the weight of the full truck and the weight we can legally transport.

$$7060\ 1/8 - 4000 \text{ lbs} = 3060\ 1/8 \text{ lbs}$$

Now convert 3060 1/8 lbs into gallons

$$\frac{3,060\ 1/8 \text{ lbs}}{8\ 3/8 \text{ lbs/gal}} = \frac{24,481 \text{ lbs}}{67/8 \text{ lbs/gal}} = (24,481/8 \text{ gals})(8/67)$$
$$= 195,848,536 \text{ gals} = 365\ 26/67 \text{ gals}$$

To be within the regulations, we can transport 365 gallons of water.

A. Problems with Solutions

1. Find the total amount of steel needed. (Do not consider any waste.)

	Type	Lengths Needed
(a)	[	4 1/4', 4 2/3', and 7 1/6'
(b)	L	5 1/2', 8', and 12 1/6'
(c)	∅	11 1/3', 4', 2 3/4', and 5 1/4'
(d)	R	1/2', 5 7/12', 4 1/3', and 5 1/4'

Solution:

Need to add up the lengths of each type.

(a) 4 1/4' + 4 2/3' + 7 1/6' = 4 3/12' + 4 8/12' + 7 2/12'
= 15 13/12'
= 16 1/12' or 16 ft 1 in of type [

(b) 5 1/2' + 8' + 12 1/6' = 5 6/12' + 8' + 12 2/12'
= 25 8/12' = 25 2/3' or 25 ft 8 in of type L

(c) 11 1/3' + 4' + 2 3/4' + 5 1/4' = 11 4/12' + 4' + 2 9/12' + 5 3/12'
= 22 16/12' = 23 4/12'
= 23 1/3' or 23 ft 4 in of type ∅

(d) 1/2' + 5 7/12' + 4 1/3' + 5 1/4' = 6/12' + 5 7/12' + 4 4/12' + 5 3/12'
= 14 20/12' = 15 8/12' = 15 2/3'
or 15 ft 8 in of type R

2. A 39" piece of flat bar is to have 11 equally spaced holes drilled on the center line of the bar. The two end holes are to be 1 3/4" from the end of the bar. What will the distance be between each consecutive hole?

Solution:

Need to subtract the two end lengths from the total length and then divide the remaining lengths into 10 equal parts.

End lengths = 1 3/4" + 1 3/4" = (2)(1 3/4") = $\left(\frac{2}{1}\right)\left(\frac{7"}{4}\right) = \frac{14"}{4}$
= $\frac{7"}{2}$ = 3 1/2"

Remaining length = 39" - 3 1/2" = 38 2/2" - 3 1/2" = 35 1/2"

10 equal parts = $\frac{35\ 1/2"}{10} = \left(\frac{71"}{2}\right)\left(\frac{1}{10}\right) = \frac{71"}{20}$ = 3 11/20"

The distances between consecutive holes is 3 11/20" or 3.55"

A. Problems with Solutions (continued)

3. How many pieces 8 3/16" F.B. can be cut from a piece of 20' stock if you allow for a 1/4" kerf. (Kerf is the width of the saw or flame cut.)

Solution:

Need to add the kerf width to the length of the F.B. to be cut. Then divide this length into the total lengths.

8 3/16" + 1/4" = 8 3/16" + 4/16" = 8 7/16"
Now change 20 feet to inches
(20 feet)(12"/foot) = 240"

$$\frac{240 \text{ in}}{8\ 7/16 \text{ in/piece}} = \frac{240 \text{ piece}}{135/16} = \frac{(240 \text{ piece})(16/135)}{} = \frac{3{,}840 \text{ piece}}{135}$$

$$= \frac{256}{9} = 28\ 4/9 \text{ pieces}$$

So we can get, at most, 28 pieces.

B. Problems without Solutions

4. Find the total amount of each type of steel needed. (Do not consider any waste)

	Type	Lengths Needed
(a)	∅	22 pieces 7 3/4" in length
(b)	L	7 pieces 8 1/2' in length
(c)	I	3 pieces 5 7/12' in length

Solution:

B. Problems without Solutions (continued)

5. How many pieces of 10 5/16" bar can be cut from a stock 20' bar. The material is to be torch cut and an allowance of a 3/16" kerf is to be made.

   Comments: kerf is the width of the saw or flame cut (the amount of material lost due to the cut.)

   Solution:

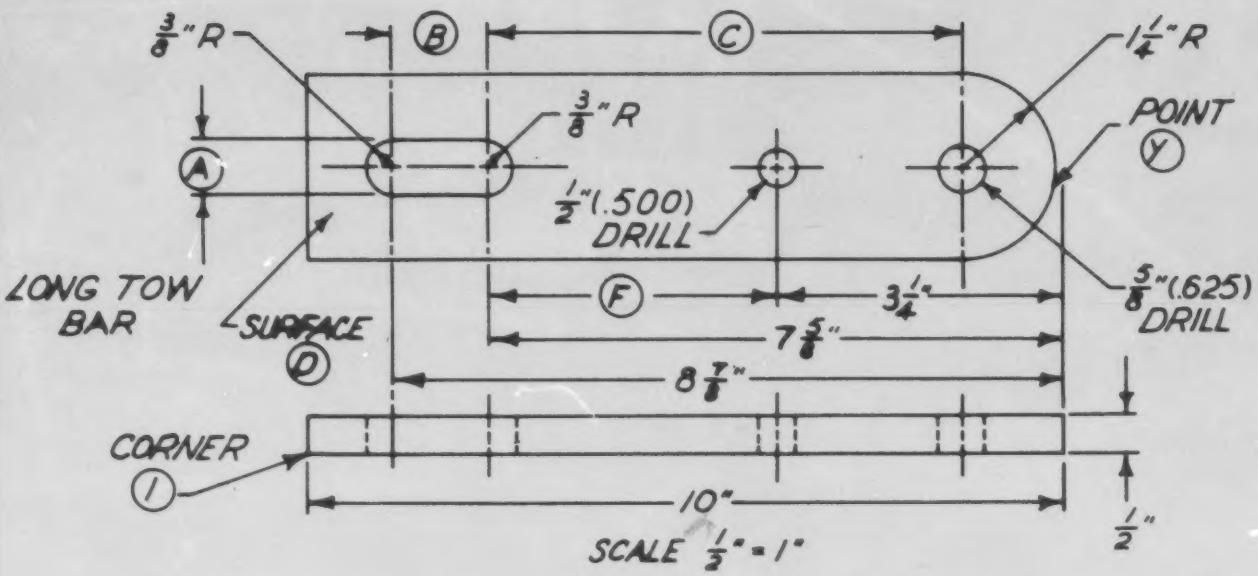
6. If an I-beam is to be cut into sections with the given tolerance, find the longest and shortest acceptable lengths:

	Length of Section	Tolerance
(a)	22 1/2"	± 1/4"
(b)	2' 7"	± 1/2"
(c)	13'	± 1 1/2"
(d)	23 3/4"	+ 1/8", -1/2"
(e)	2' 1/8"	+ 1/4", -3/16"

Solution:

B. Problems without Solutions (continued)

7. Find distances A, B, C, and F on the given blueprint.



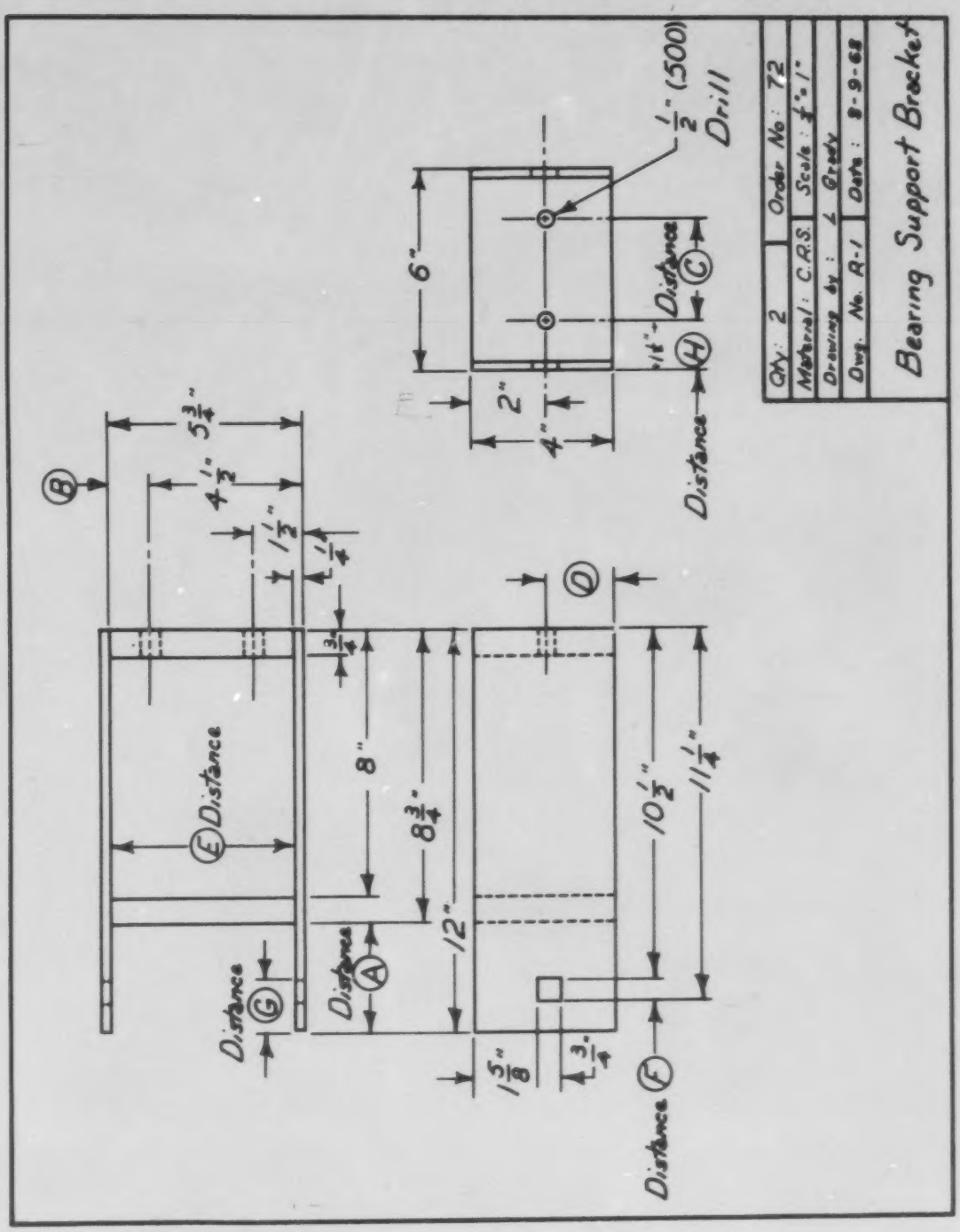
Solution:

B. Problems without Solutions (continued)

8. The center points of two holes drilled in a piece of F.B. are 18 3/4" apart. Two more holes are to be equally spaced between these two holes. Locate the center point of each of the remaining holes.

B. Problems without Solutions (continued)

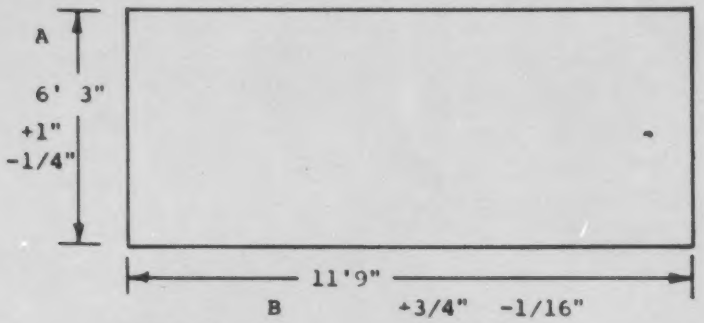
9. On the blueprint below find each of the indicated measurements, A through H.



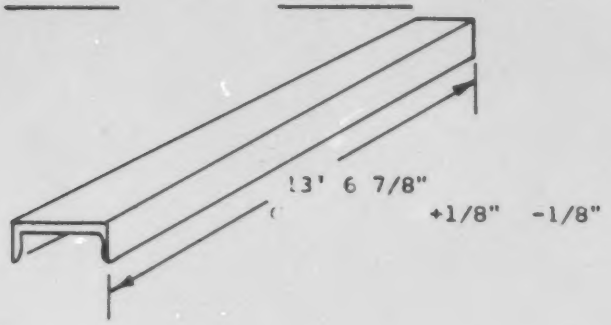
WELD-6

B. Problems without Solutions (continued)

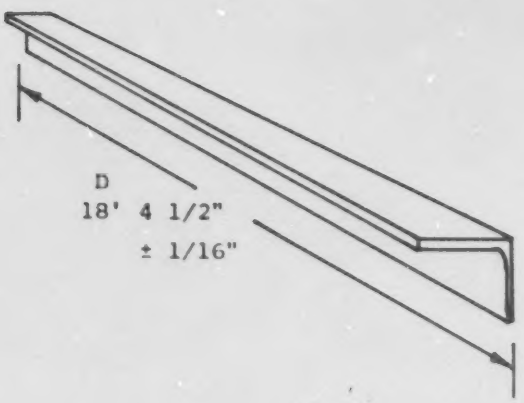
10. Compute the tolerances for the given measurements for each figure.



	Longest	Shortest
A	_____	_____
B	_____	_____



C _____ _____



I _____ _____

Complete Solutions to B Problems

4. Need to multiply the number of pieces by the required lengths for each type of steel

(a) $(22)(7\ 3/4") = \left(\frac{22}{1}\right)\left(\frac{31}{4}\right) = \frac{682}{4} = 170\ 1/2"$

We need 170 1/2" or 14 5/24 ft of type Ø

(b) $(7)(8\ 1/2') = \left(\frac{7}{1}\right)\left(\frac{17'}{2}\right) = \frac{119}{2} = 59\ 1/2'$

We need 59 1/2 ft of type L

(c) $(3)(5\ 7/12') = \left(\frac{3}{1}\right)\left(\frac{67}{12}\right) = \frac{201'}{12} = 16\ 3/4'$

We need 16 3/4 ft of type I

5. Need to add the kerf to length to be cut and then divide the total length by that length.

10 5/16" + 3/16" = 10 8/16" = 10 1/2"

20' = 240"

$$\frac{240\ in}{10\ 1/2\ in/piece} = \frac{240}{21/2}\ piece$$

$$= \left(\frac{240\ piece}{1}\right)\left(\frac{2}{21}\right) = \frac{480\ piece}{21}$$

$$= 22\ 6/7\ pieces$$

So we can get, at most, 22 pieces that are 10 5/16 inches long.

6. Need to add and subtract the tolerance from the length of the section.

(a) 22 1/2" + 1/4" = 22 2/4" + 1/4" = 22 3/4"
22 1/2" - 1/4" = 22 2/4" - 1/4" = 22 1/4"

(b) 31" + 1/2" = 31 1/2"
31" - 1/2" = 30 2/2" - 1/2" = 30 1/2"

(c) 156" + 1 1/2" = 157 1/2"
156" - 1 1/2" = 154 4/2" - 3/2" = 154 1/2"

(d) 23 3/4" + 1/8" = 23 6/8" + 1/8" = 23 7/8"
23 3/4" - 1/2" = 23 3/4" - 2/4" = 23 1/4"

(e) 24 1/8" + 1/4" = 24 1/8" + 2/8" = 24 3/8"
24 1/8" - 3/16" = 23 9/8" - 3/16" = 23 18/16" - 3/16"
= 23 15/16"

Complete Solutions to B Problems (continued)

7. Need to determine the distances by adding and/or subtracting the given measurements.

(a) 3/8" + 3/8" = 6/8" = 3/4 in

(b) 8 7/8" - 7 5/8" = 1 2/8" = 1 1/4 in

(c) 7 5/8" - 1 1/4" = 7 5/8" - 1 2/8" = 6 3/8 in

(f) 7 5/8" - 3 1/4" = 7 5/8" - 3 2/8" = 4 3/8 in

8. Need to divide the total length by the number of lengths between the holes.

$$\frac{18\ 3/4"}{3} = \frac{75/4"}{3} = \left(\frac{75"}{4}\right)\left(\frac{1}{3}\right) = \frac{75"}{12} = 6\ 1/4\ \text{in}$$

9. Need to add and/or subtract given lengths to determine the unknown distances.

(a) 12" - 8 3/4" = 11 4/4" - 8 3/4" = 3 1/4"

(b) 5 3/4" - 4 1/2" = 5 3/4" - 4 2/4" = 1 1/4"

(c) (6" - 1 1/2") - 1 1/2" = (5 2/2" - 1 1/2") - 1 1/2"
= 4 1/2" - 1 1/2" = 3"

(d) 4" - 2" = 2"

(e) 5 3/4" - 1/4" = 5 1/2"

(f) 11 1/4" - 10 1/2" = 10 5/4" - 10 2/4" = 3/4"

(g) 12" - 10 1/2" = 11 2/2" - 10 1/2" = 1 1/2"

(h) 1 1/2"

Complete Solutions to B Problems (continued)

		Longest	Shortest
10.	A	6' 4"	6' 2 3/4"
	B	11' 9 3/4"	11' 8 15/16"
	C	13' 7"	13' 6 3/4"
	D	18' 4 9/16"	18' 4 7/16"

B. Problems without Solutions

1. How many horsepower must be applied to raise 2 tons a distance of 100 feet in 1 minute?

Complete Solutions to B Problems

1. $1 \text{ hp} = \frac{550 \text{ ft lb}}{1 \text{ sec}} = \frac{33{,}000 \text{ ft lb}}{1 \text{ min}}$

$$\left(\frac{(2 \text{ ton})(100 \text{ ft})}{1 \text{ min}}\right)(1 \text{ min}/60 \text{ sec})(2{,}000 \text{ lb/ton}) = \frac{20{,}000 \text{ ft-lb}}{3 \text{ sec}}$$

$$\left(\frac{20{,}000 \text{ ft lb}}{3 \text{ sec}}\right)\left(\frac{1 \text{ hp}}{550 \text{ ft lb/sec}}\right) = 12.12 \text{ hp}$$

B. Problems without solutions

1. What would the outlet voltage be on a 115 volt line that has a voltage drop of $5\frac{3}{4}$ volts from panel bus to outlet?

Complete solutions to B problems

1. $115V \text{ (Volts)} = 114\frac{4}{4} V$

$-5\frac{3}{4} V = -5\frac{3}{4} V$

$109\frac{1}{4} V$

Check solution by addition

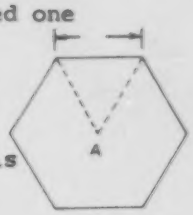
$$\begin{array}{r} 109\frac{1}{4} \\ +\ 5\frac{3}{4} \\ \hline 114\frac{4}{4} = 115 \end{array}$$

FRACTIONS
Level 1

Diesel Mechanic

A. Problems with Solutions

1. The drawing represents the head of a bolt. If it is tightened one hex of the head, how many degrees would this be?

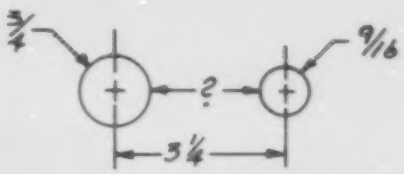


Solution:

Since there are 360° around point A, and since one hex is 1/6 of head, 1/6 of 360° = 60°

2. A 3/4" shaft center is positioned 3 1/4" from the center of a 9/16" shaft. What should the spacing between the shafts be?

Solution:

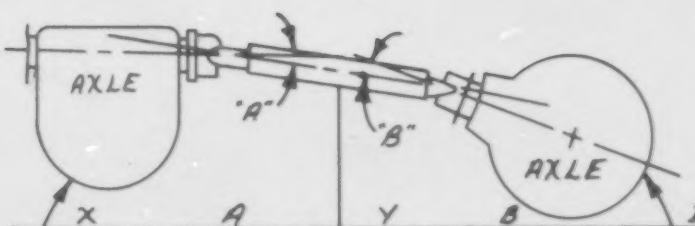


$$3\ 1/4 - \left[(1/2)(3/4) + (1/2)(9/16)\right]$$

13/4 - (3/8 + 9/32) = 13/4 - 21/32 = 83/32 or 2 19/32 inches

Level 2

3.



ANGLE 1 1/2°	ANGLE "A" 6 1/2	ANGLE LENGTH 8	ANGLE "B" 1/2	ANGLE 8 1/2	BEFORE
3	3 1/2	6 1/2	3	9 1/2	AFTER

A problem concerning drive line attitudes involving a dual axle is as follows: It is desired that the angles at A and B be equal or as nearly so as possible. Increasing the declination of the rear axle will also alter the forward axle, and can be determined by measurement.

A. Problems with Solutions (continued)

3. (continued)

As a specific example, it was determined that the angle of the front axle was 1 1/2° (column X), and the angle length was 8° (column Y). Angle A is determined by taking the difference, 8° - 1 1/2° = 6 1/2°. (i.e. Y - X) Angle B is determined by taking the difference of the rear axle angle 8 1/2° (column Z) and 8° (column Y). (i.e. Z - Y) 8° - 8 1/2° = 1/2° .

A change of the rear axle to 9 1/2° effected a change in column Y from 8° to 6 1/2° and in column X from 1 1/2° to 3°. Then, A turns out to be 3 1/2° and B equal to 3°, a more desireable drive line attitude. Consider the following given data and compute angles A and B in the "Before" row.

	X	A	Y	B	Z
Before	2°	_____	8°	_____	9°
After					

Solution:

A = 8 - 2 = 6 B = 9 - 8 = 1

The "before" row is as follows:

	X	A	Y	B	Z
Before	2	6	8	1	9
After					

4. If, to make a correction, the Z value is increased to 10, what change must occur in Y so B = 3?

Solution:

10 - ? = 3 Y must be 7

5. If Y is 7, then how must X change so that A is 3?

Solution:

7 - ? = 3 X must be 4

A. Problems with Solutions (continued)

5. (continued)

The table will read as follows:

	X	A	Y	B	Z
Before	2	6	8	1	9
After	4	3	7	3	10

6. Fill in the following tables in a similar manner using the previous information.

	X	A	Y	B	Z
Before	2½		7½		8½
After		3		3	10

	X	A	Y	B	Z
Before	3		7		9
After		3		3	10

A. Problems with Solutions (continued)

6. (continued)

Solution:

	X	A	Y	B	Z
Before	2½	5	7½	1	8½
After	4	3	7	3	10

	X	A	Y	B	Z
Before	3	4	7	2	9
After	4	3	7	3	10

Level 1

B. Problems without Solutions

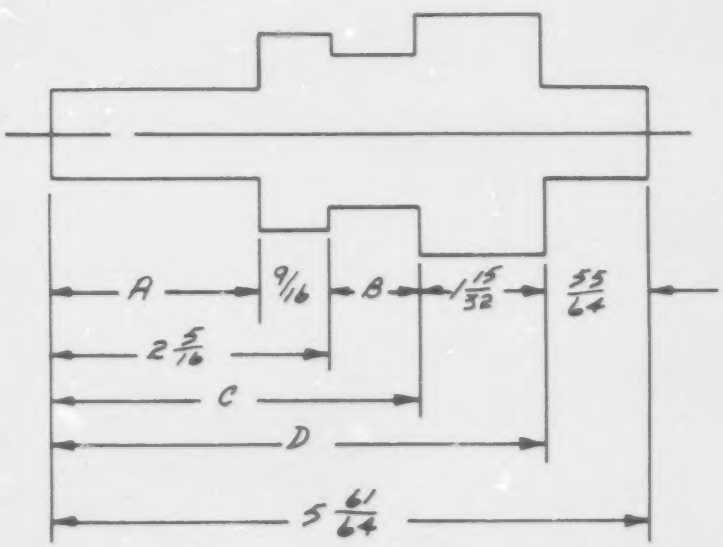
7. Fan belt tension may be measured by pushing down on the belt with the index figure pointed straight down from the hand. When testing in this manner, you should be able to depress or deflect a 1/2" fan belt 3/8" for every foot of span between pulleys. (a) What should the deflection of a fan belt be if the span between pulleys is 2 ft? (b) What would the deflection be if the span between pulleys on an engine you were checking was 1 1/2 ft?

B. Problems without Solutions (continued)

8. A change in flange thickness of 0.001" will change the position of an indicator by 11 1/2°. What will the change be in the position of the indicator for a change in the flange thickness of 0.002"?

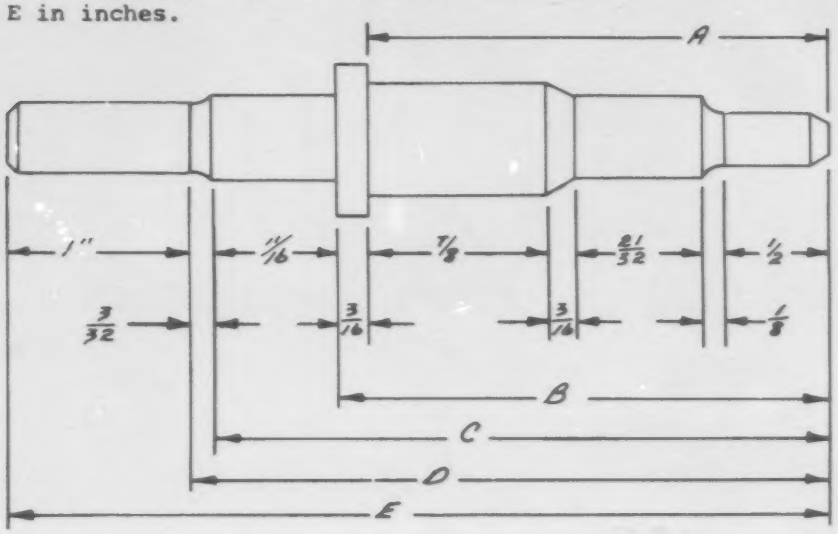
9. An alloy called "antifriction metal" is 37/1000 copper, 111/125 tin, and 3/40 antimony. Find the weight of each metal in a mass of the alloy weighing 1,250 pounds.

10. In the diagram below, determine the unknown A, B, C, and D. Units are inches.



B. Problems without Solutions (continued)

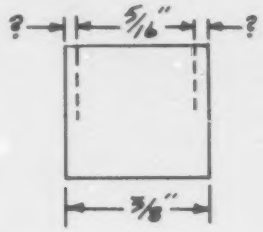
11. In the diagram below, determine the measures of A, B, C, D, and E in inches.



12. If a 1/8" hole is drilled 1/4" on center from the bottom of a plate, how far is the edge of the hole from the bottom of the plate?

B. Problems without Solutions (continued)

13. 5/16" and 3/8" are the keyways in a pulley and shaft, respectively. Because parts are unavailbable, it is necessary to shim some from each side of a 3/8" key. How much has to be shimed from each side of a portion of the key?



Complete Solutions to B Problems

7. (a) $(3/8")(2) = 6/8" = 3/4"$

(b) $(3/8")(1\ 1/2) = (3/8")(3/2) = 9/16"$

8. $(2)(11\ 1/2^{c}) = 23^{c}$

9. $(37/1000)(1250\ lb) = 46\ 1/4$ pounds (copper)

$(111/125)(1250\ lb) = 1110$ pounds (tin)

$(3/40)(1250\ lb) = 93\ 3/4$ pounds (antimony)

10. $A = 2\ 5/16 - 9/16 = 1\ 21/16 - 9/16 = 1\ 12/16 = 1\ 3/4$ inches

$B = 5\ 61/64 - (2\ 5/16 + 1\ 15/32 + 55/64)$

$= 5\ 61/64 - 4\ 41/64 = 1\ 20/64 = 1\ 5/16$ inches

$C = 2\ 5/16 + 1\ 5/16 = 3\ 10/16 = 3\ 5/8$ inches

$D = 3\ 5/8 + 1\ 15/32 = 3\ 20/32 + 1\ 15/32 = 4\ 35/32 = 5\ 3/32$ inches

11. $A = 1/2 + 1/8 + 21/32 + 3/16 + 7/8$

$= \frac{16 + 4 + 21 + 6 + 28}{32} = \frac{75}{32} = 2\ 11/32$ inches

$B = A + 3/16 = 2\ 11/32 + 6/32 = 2\ 17/32$ inches

$C = B + 11/16 = 2\ 17/32 + 22/32 = 2\ 39/32 = 3\ 7/32$ inches

$D = C + 3/32 = 3\ 7/32 + 3/32 = 3\ 10/32 = 3\ 5/16$ inches

$E = D + 1 = 3\ 5/16 + 1 = 4\ 5/16$ inches

12. A 1/8" hole has a radius of $(1/2)(1/8) = 1/16$. So, $1/4 - 1/16 = 4/16 - 1/16 = 3/16$ in.

13. $\frac{3/8" - 5/16"}{2} = \frac{1/16"}{2} = 1/32$ inches

A. Problems with Solutions

1. The Finishing Dept. puts out 1,840 units per hour. Of this amount Joe finishes 230 units. What fraction of the work is he doing?

Solution:

$$\text{The fraction of work done by Joe} = \frac{230 \text{ units}}{1{,}840 \text{ units}}$$

$$= 1/8$$

2. During the week the stockroom issued the following amounts of No. 206 nails.

Monday	26 7/8 lbs
Tuesday	18 1/3 lbs
Wednesday	21 5/16 lbs
Thursday	24 3/8 lbs
Friday	19 7/16 lbs
Total	_____ lbs

If there were 206 1/8 lbs on hand at the beginning of the week, how many pounds were remaining in stock at the end of the week?

Solution:

26 7/8 lb + 18 1/3 lb + 21 5/16 lb + 24 3/8 lb + 19 7/16 lb =

26 42/48 lb + 18 16/48 lb + 21 15/48 lb + 24 18/48 lb + 19 21/48 lb =

108 112/48 lb = 110 1/3 lbs

Amount remaining = 206 3/24 lbs - 110 8/24 lbs
= 205 27/24 lbs - 110 8/24 lbs
= 95 19/24 lbs

3. Mr. Sawyer worked 39 hours regular time, 15 hours overtime at time and a half, and 9 hours at double time. If his regular rate was $2.60 an hour, how much did he earn?

Solution::

Regular pay for 39 hours	= (39 hrs)($2.60/hr)	= $101.40
Overtime at time and half	= (15 hrs)($2.60/hr)(1.5)	= 58.50
Overtime at double time	= (9 hrs)($2.60/hr)(2)	= 46.80
	Total earnings	$206.70

A. Problems with Solutions (continued)

4. A typist was given a manuscript of 324 pages to type. She received $2.75 per hour for her work. If it took her 72 hours to complete the job, how many pages on an average did she type per hour? What were her total gross earnings?

Solution:

$$\frac{324 \text{ pages}}{72 \text{ hrs}} = 4\ 1/2 \text{ pages per hour}$$

Total gross earnings = ($2.75/~~hr~~)(72 ~~hrs~~) = $198

5. $100 was divided among three people. The first received 2/5 of the amount and the second received 1/4. How much did each of three people receive?

Solution:

First person receives = ($100)(2/5) = $40
Second person receives = ($100)(1/4) = $25
Third person receives = (($100 - $40) - $25) = $35

B. Problems without Solutions

6. Mr. Jones must have new baseboard installed in two offices. One office is 12 3/4 ft by 14 2/3 ft with a 3 ft door. The other office is 13 1/6 ft by 17 1/2 ft with a 2 1/2 ft door. How many feet of baseboard should Mr. Jones order?

Solution:

B. Problems without Solutions (continued)

7. Extend the following invoice:

12 3/8 yards @ 74 2/5¢ _____

38 1/2 yards @ 58 1/3¢ _____

47 5/6 yards @ 28 1/2¢ _____

TOTAL _____

Solution:

8. A freight car which is 7/16 full takes on an additional load of 1/5 of its capacity. At its first delivery stop, 3/8 of its capacity is delivered. What fraction of its capacity is now available for use?

Solution:

9. If 1/20 of each paycheck is deducted for insurance, what is the total annual salary of a man who receives $1,710.00 each month after the deduction has been made?

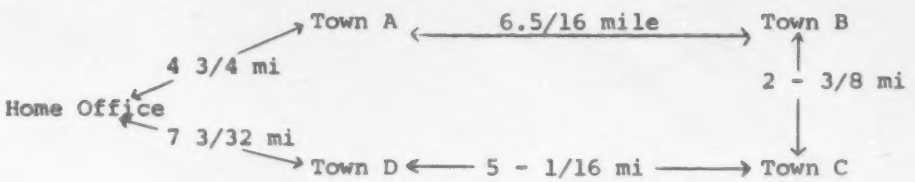
Solution:

B. Problems without Solutions (continued)

10. Distances between stops on a salesman's route are shown below. The salesman covers the route three times a week.

(a) How many miles a week does he travel?

(b) If it costs 12¢ a mile to operate his car, what would the yearly cost be?



Solution:

11. Calculate the cubic feet of storage in a bin which measures 2 5/12 ft by 3 1/8 ft by 1 3/4 ft. (length x width x depth)

Solution:

12. Total area of Grey's Lumber Mill is 1,773 sq ft. The parts department occupies 591 sq ft. What fraction of the total space does the parts department occupy?

Solution:

B. Problems without Solutions (continued)

13. A machine which produces 118 1/4 units per hour runs 37 1/2 hours a week. How many units does it produce each week?

Solution:

14. Miss Brown typed, on an average, 2 1/2 stencils per hour for 8 hours. If she was paid $3.50 per hour, what was the cost of typing per stencil?

Solution:

15. Mr. Smith worked for the local laundry at $1.70 an hour. Overtime was figured at time and a half. If he worked 8 hours on Monday, 10 hours on Tuesday, 8 1/2 hours on Wednesday, 8 hours on Thursday, and 9 hours on Friday, what was his gross pay for the week based on a 40 hour week?

Solution:

16. The A & B Co. pays 1 1/2 times the regular rate for all overtime in excess of 40 hours during the week except for Sunday when it pays twice the regular rate. How much would an employee earn who had worked 46 1/2 hours during the week and 6 hours on Sunday if his regular rate was $1.80 per hour?

Solution:

B. Problems without Solutions (continued)

17. Mr. White owned 1/3 of a business, Mr. Hoyt owned 1/2, Mr. Evans owned 1/9 and Mr. Baines owned the remainder. If Mr. Baines' share was worth $3,700, how much were the shares held by each of the other partners worth?

Solution:

18. Howard Butler received $96.00 for a 40-hour week and time and a half for overtime. Compute his earnings for a week in which he worked 48 hours.

Solution:

B. Problems without Solutions (continued)

19. A clerk cannot find the production figures for two years ago. He has last year's figures showing 511,000 units produced and remembers figuring that last year's production was up approximately 1/6 over the year before. Approximately what was the production two years ago?

Solution:

20. If it requires 16 weeks at 40 hours per week for 22 men to complete a job, how many weeks would it take them to complete the job working 56 hours per week if they accomplish only 9/10 as much per hour when working for a greater number of hours per week?

Solution:

Complete Solutions to B Problems

6. We add the perimeters of both rooms and subtract the door widths

12 3/4 ft + 12 3/4 ft + 14 2/3 ft + 14 2/3 ft - 3 ft =

12 9/12 ft + 12 9/12 ft + 14 8/12 ft + 14 8/12 ft - 3 ft =

49 34/12 ft = 51 5/6 ft

17 1/2 ft + 17 1/2 ft + 13 1/6 ft + 13 1/6 ft - 2 1/2 ft =

17 3/6 ft + 17 3/6 ft + 13 1/6 ft + 13 1/6 ft - 2 3/6 ft =

58 5/6 ft

51 5/6 ft + 58 5/6 ft = 110 2/3 ft

7. (12 3/8 yds)($0.74 2/5/yd) = (99/8)($3.704/5)
= $9.167
(38 1/2 yds)($0.58 1/3/yd) = (77/2)($1.7433/3)
= $22.372
(47 5/6 yds)($0.28 1/2/yd) = (276/6)($0.565/2)
= $13.513
TOTAL = $9.167 + $22.372 + $13.513 = $45.052 = $45.05

8. 7/16 + 1/5 = 35/80 + 16/80 = 51/80 amount of capacity that the car carries
51/80 - 3/8 = 51/80 - 30/80 = 21/80 amount of capacity now available

9. $1,710 is 19/20 of the paycheck before deductions
$1,710 = (19/20)x x = total monthly salary
$34,200 = 19x
$1,800 = x
total annual salary = ($1,800)(12) = $21,600

10. (a) 4 3/4 mi + 6 5/16 mi + 2 3/8 mi + 5 1/16 mi + 7 3/32 mi =
4 24/32 mi + 6 10.32 mi + 2 12/32 mi + 5 2/32 mi + 7 3/32 mi =
24 51/32 mi = 25 19/32 miles per trip
(25 19/32 mi/trip)(3 trips/week) = 75 57/32 mi/week
= 76 25/32 mi/week

(b) (76 25/32 mi/week)(52 weeks/yr) = 3,952 1300/32 mi/yr
3,992 5/8 mi/yr
(3,992 5/8 mi/yr)($0.12/mi) = $479.12 per year

Complete Solutions to B Problems (continued)

11. $\left(\frac{29}{12}\text{ ft}\right)\left(\frac{25}{8}\text{ ft}\right)\left(\frac{7}{4}\text{ ft}\right) = \frac{5075}{384}\text{ cu ft}$

$= 13\frac{83}{384}\text{ cu ft}$

12. $\frac{591\text{ sq ft}}{1{,}773\text{ sq ft}} = \frac{1}{3}$

13. (118 1/4 units/hr)(37 1/2 hr/week) = (473/4 units/~~hr~~)(75/2 ~~hr~~/week)
= 4,434 3/8 units per week

14. (2 1/2 stencils/~~hr~~)(8~~hr~~) = 20 stencils
(8 ~~hr~~)($3.50/~~hr~~) = $28.00
$\frac{\$28.00}{20\text{ stencils}}$ = $1.40 per stencil

15. 8 hrs + 10 hrs + 8 1/2 hrs + 8 hrs + 9 hrs = 43 1/2 hrs
Base pay = (40 ~~hrs~~)($1.70/~~hr~~) = $68.00
Overtime pay = (3 1/2 ~~hr~~)($1.70/~~hr~~)(1.5) = 8.93
Gross Pay $76.93

16. (40 ~~hrs~~)($1.80/~~hr~~) = $72.00
(6 1/2 ~~hrs~~)($1.80/~~hr~~)(1.5) = 17.55
(6 ~~hrs~~)($1.80/~~hr~~)(2) = 21.60
Gross Pay $111.15

17. x = Mr. Baines' share
1/3 + 1/2 + 1/9 + x = 1
6/18 + 9/18 + 2/18 + x = 1
x = 1/18

B = total amount in business
$3,700 = (1/18)B
($3,700)(18) = B
$66,600 = B

Mr. White (1/3)($66,600) = $22,200

Mr. Hoyt (1/2)($66,600) = $33,300

Mr. Evans (1/9)($66,600) = $ 7,400

18. $\frac{\$96.00}{40\text{ hrs}}$ = $2.40 per hour

(40 ~~hrs~~)($2.40/~~hr~~) = $96.00
(8 ~~hrs~~)($2.40/~~hr~~)(1.5) = 28.80
Gross Pay $124.80

Complete Solutions to B Problems (continued)

19. x = production of two years ago
511,000 units = (7/6)x
3,066,000 units = 7x
438,000 units = x

20. (16 weeks)(40 hours/week)(22) = 14,080 hrs to complete job

$w\left(\frac{9}{10}\right)(56 \text{ hrs/week})(22) = 14{,}080 \text{ hrs}$

$w\left(\frac{504}{10} \text{ hrs/week}\right)(22) = 14{,}080 \text{ hrs}$

$w = (14{,}080 \text{ hrs})\left(\frac{10}{11{,}088 \text{ hr/week}}\right)$

$w = \frac{140{,}800 \text{ hr} \times \text{week}}{11{,}088 \text{ hr}}$

$w = 12\frac{7{,}744}{11{,}088}$ weeks

$w = 12\frac{44}{63}$ weeks

A. Problems with Solutions

1. What is the thickness of a table top made of 3/4-inch plywood and covered with 3/16-inch glass?

Solution:

Total thickness = thickness of 1st component + thickness of 2nd component

= 3/4" + 3/16"

Convert 3/4" into x/16"

(3/4")(4/4) = 12/16"

Total = 12/16" + 3/16" = 15/16"

2. How many pieces of lumber 1 5/8 inches wide will be needed to cover a space 39 inches wide?

Solution:

$$\text{Number of pieces} = \frac{\text{Total inches}}{\text{inches/sheet}}$$

$$= \frac{39 \text{ in}}{1\ 5/8 \text{ in/sheet}}$$

$$= \frac{39 \text{ in}}{13/8 \text{ in/sheet}}$$

$$= (39 \text{ in})(8/13 \text{ sheets/in})$$

$$= 24 \text{ sheets}$$

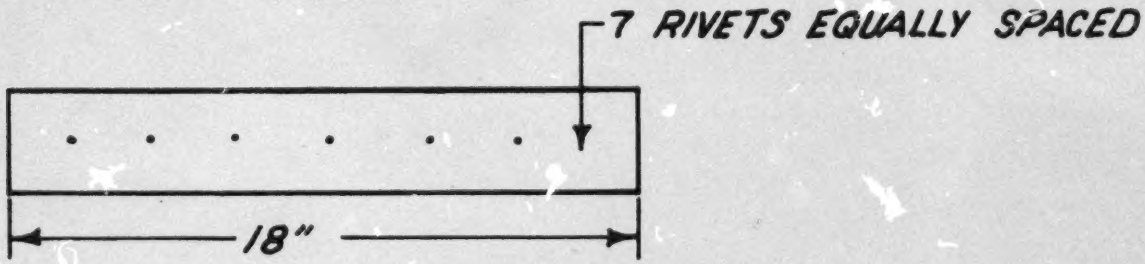
B. Problems without Solutions

3. A carpenter needed a piece of lumber 2 7/8 inches wide. How wide a piece is left if the original piece was 5 5/8 inches, and 3/16 inch is allowed for the saw cut?

B. Problems without Solutions (continued)

4. What is the thickness of a wall if the stud is 3 5/8 inches, the exterior covering 11/16 inch and the interior covering 13/32 inch?

5. Compute the rivet spacing on the drawing.



6. If 5/32 inch is allowed for each cut, what will be the width of each of three equal pieces cut from a piece of lumber 7 5/8 inches wide?

B. Problems without Solutions (continued)

7. Find the length of the rivets (1/8 in diameter) needed to rivet one thickness of 28-gauge (0.0149 in thick) sheet metal and one piece of 12-gauge (0.1046 in thick) band iron to the closest 32nd of an inch.

8. How many pieces of 3/8-inch plywood are in a stack 33 inches high?

Complete Solutions to B Problems

3. Without allowing for the saw cut, the piece would be

5 5/8" - 2 7/8 = 4 13/8" - 2 7/8 = 2 6/8" = 2 12/16"

Then, subtract the amount you allow for the saw cut

2 12/16" - 3/16" = 2 9/16 inches

4. Total thickness = thickness of 1st component + thickness of 2nd component + thickness of 3rd component

= 3 5/8" + 11/16" + 13/32"

Convert to x/32: 3 5/8" = 3 20/32"

11/16" = 22/32"

Total thickness = 3 20/32" + 22/32" + 13/32"

= 3 55/32"

= 4 23/32"

5. There are 8 equal spaces in the drawing, so, divide the total length by 8 to get the spacings.

18/8" = 9/4" = 2 1/4" place a rivet every 2 1/4".

6. Since you must allow 5/32" for each of two cuts, the three pieces will be cut from a piece.

7 5/8" - 2 (5/32)" = 7 20/32" - 10/32" = 7 10/32"

This divided by three gives you the size/piece

$$\frac{7\ 10/32"}{3} = \frac{6\ 42/32"}{3} = 2\ 14/32" = 2\ 7/16"$$

7. The rivet body must pass through the two metal strips. The total thickness of these metal strips is

$$\begin{array}{r} 0.0149" \\ +\ 0.1046" \\ \hline 0.1195" \end{array}$$

Complete Solutions to B Problems (continued)

7. (continued)

The head of the rivet projects 1 1/2 times the diameter of the rivet beyond this which is (1.5) (1/8") = 0.1875"

Total length = body length + head length

$$= 0.1195" + 0.1875"$$

$$= 0.3070"$$

$$= \left(\frac{307}{1000}\right)'' \left(\frac{32}{32}\right)$$

$$= \frac{9824"}{32000}$$

$$= \left(\frac{9824"}{32000}\right)\left(\frac{1/1000}{1/1000}\right)$$

$$= \frac{9.824"}{32} \quad \text{to the nearest 32nd of an inch}$$

$$= \frac{10"}{32}$$

8. $\dfrac{33 \text{ inch}}{3/8 \text{ inch/sheet}} = (33 \text{ inch})(8/3 \text{ sheet/inch}) = 88 \text{ sheets}$

A. Problems with Solutions

1. A certain piece of work can be done by a man in 4 hours. His older brother can do the same piece of work in 5 hours. How long will it take them if they can work together? How long would it take if there was a third person working with them who could do the task by himself in 4 hours?

Solution:

The man can complete 1/4 of the task in one hour. His brother can do 1/5 of the job in the same hour. Consequently, they **complete 1/4 + 1/5 = 9/20 of the job per hour. The job then** takes 20/9 = 2 2/9 hours to complete.

If the third man is added to the crew, he will do 1/4 of the task per hour making the total work completed 9/20 + 1/4 or 14/20 = 7/10 of the job per hour. This in turn gives a time for the task of 10/7 = 1 3/7 hours.

Level 1

2. One fourth of the sludge for a day was pumped by the day crew. The swing-shift pumped one hlf of the remaining sludge. If the total sludge pumped during the two shifts was 48,320 gallons, what was the day's total sludge, and how many gallons were pumped by each shift?

Solution:

The first shift pumped 1/4 of the sludge, and the second shift pumped 1/2 x 3/4 = 3/8 of the day's sludge. Hence, together they pumped 5/8 of the day's total.

$$\frac{48{,}320 \text{ gal}}{5/8} = 77{,}312 \text{ gal}$$

(77,312 gal)(1/4) = 19,328 gallons
(77,312 gal)(3/8) = 28,992 gallons

3. Seven ninths of the total flow of raw sewage made up the flow to a trickling filter. The measured flow to this trickling filter was 19.27 MGD. What was the raw sewage flow? How many gallons of the raw flow were by-passed by this filter?

Solution:

19.27 MGD = 7/9 raw flow
Raw flow = (19.27 MGD)(9/7) = 24.78MGD
By-passed = 24.78 MGD - 19.27 MGD = 5.51 MGD

We should note here that even though the problem is stated in terms of fractions, flow is ALWAYS given as decimal MGD.

B. Problems without Solutions

4. A 2.5-yard truck is used to haul away sludge from the local treatment plant. If the sludge bed is 60 feet by 100 feet and is filled to a depth of one foot, how many trips will the truck have to make to empty the bed?

5. On Tuesday, the supernatent drawn off was 1/3 more than that which was drawn off on Monday. If the total supernatent drawn off for the two days was 284,200 gallons, how much was drawn off each day?

Level 2

6. Last Friday the flow of raw sewage into the treatment plant was 3/4 that of a normal Monday flow. The next day the raw flow dropped to 5/6 of the Friday flow, and the flow on Sunday was only 5/6 of the flow on Saturday. The flow for Sunday was 25 MGD. What was the flow on Friday? Saturday? A typical Monday?

B. Problems without Solutions (continued)

7. A treatment plant with a capacity of 2 MGD has a daily flow equal to 2/5 of capacity. One seventh of the daily flow is industrial waste. How many gallons of industrial waste are treated daily?

8. Rain causes an increase in flow equal to 1/3 plant capacity. What is the wet weather flow? Refer to problem #7.

9. A pumping station has 3 pumps that are run continuously. The motors are 3 hp, 5 hp and 7-1/2 hp. If the total power cost is $200/mo, what amount should be charged to each pump?

Complete Solutions to B Problems

4. The bed contains (60 ft)(100 ft)(1 ft) = 6,000 cu ft

Converting, (6000 cu ft)(1 cu yd/27 cu ft) = 222.22 cu yds

$$\frac{222.22 \text{ cu yds}}{2.5 \text{ cu yds/trip}} = 88.89 \text{ trips}$$ so, 89 trips

5. Since Tuesday is 1/3 more than Monday, we have 284,200 gallons being 7/3 of the Monday flow.

284,200 gallons = 7/3 Monday

$$\frac{284{,}200 \text{ gallons}}{7/3} = \text{Monday} = 121{,}800 \text{ gallons}$$

Tuesday = 4/3 Monday = (4/3)(121,800 gal) = 162,400 gallons

6. We know that Friday = 3/4 Monday and Saturday = 5/6 Friday. Hence, we establish Saturday as (3/4)(5/6) = 5/8 Monday. Sunday is given as 5/6 of Saturday , so, Sunday becomes 25/48 of the typical Monday flow.

Sunday = 25 MGD = 25/48 Monday
Therefore, Monday = 48 MGD
Friday = 3/4 Monday = (3/4)(48 MGD) = 36 MGD
Saturday = 5/6 Friday = (5/6)(36 MGD) = 30 MGD

7. Daily flow = (2/5)(2 MGD) = 4/5 MGD

Industrial waste = (1/7)(4/5 MGD) = 4/35 MGD

8. Increase in flow = (1/3)(2 MGD) = 2/3 MGD

Wet weather flow = 2/3 MGD + 4/5 MGD
= 10/15 MGD + 12/15 MGD
= 22/15 MGD = 1 7/15 MGD

9. Total hp = 3 hp + 5 hp + 7 1/2 hp = 15 1/2 hp = 31/2 hp

Charge to 3 hp pump = $\frac{(3)(\$200)}{31/2}$ = \$38.71

Charge to 5 hp pump = $\frac{(5)(\$200)}{31/2}$ = \$64.52

Charge to 7 1/2 hp pump = $\frac{(7\ 1/2)(\$200)}{31/2}$ = \$96.77

A. Problems with Solutions

1. The toe in setting on a 1971 Buick is 1/8" - 1/4". What should the preferred setting be?

   Solution:

   $$\text{Toe in preferred setting} = \frac{1/8" + 1/4"}{2} = 3/16 \text{ in}$$

2. To align a frame the exact center of each of the four crossmembers was found by measurement. Then with the frame on stands at each corner, plum bobs were dropped from each crossmember center and a straight line was drawn on the floor. The front and rear bobs were on the line, the second bob was 2 3/8" to the left of the line and the third was 1 15/16" to the right of the line. What total distance is the frame out of line?

   Solution:

   $$\text{Total distance out of line} = 2\ 3/8" + 1\ 15/16"$$
   $$= 2\ 6/16" + 1\ 15/16"$$
   $$= 4\ 5/16 \text{ in}$$

3. The camber setting on a 1970 Buick Riviera is 1/4" N - 3/4" P. What would the preferred setting be? (N: negative; P: positive)

   Solution:

   1/4" N - 3/4" P = 1" distance

   Preferred setting is 1/2 the distance from one extreme to the other.

   Preferred setting = 1/4" N + 1/2" = 1/4" P

B. Problems without Solutions

4. In squaring up a damaged frame, it was set on four pedestals each 17" high. The left front corner was lowered to 15 1/8" in order to equalize the center depth at 13". The frame was locked down and a jack was placed to raise the left front corner. How high must it be raised?

5. In squaring a frame the diagonals were measured between the two front crossmembers. They were 77 3/16" and 69 5/8". How much difference must be equalized?

6. The cam gear on a 350 Chevrolet has 38 teeth and the crankshaft gear has 19 teeth. If the crankshaft gear is 2 7/8" pitch diameter, what is the pitch diameter of the cam gear?

7. If the firing order on an eight cylinder engine is 1, 6, 2, 5, 8, 3, 7, 4 and the engine is turning 3,000 RPM, how long a time lapse is there between the firing of cylinders 1 and 1, cylinders 1 and 8, cylinders 1 and 6, cylinders 8 and 7, cylinders 1 and 5?

Complete Solutions to B Problems

4. Distance to be raised = 17" - 15 1/8" = 1 7/8 in

5. Difference to be equalized = 77 3/16" - 69 5/8"

= 76 19/16" - 69 10/15"

= 7 9/16 in

6. Pitch diameter of cam gear = (2)(2 7/8") = 5 6/8" = 5.75 in

7. #1 to #1 firing sequence would be 2 revolutions at 3,000 RPM. This is 50 revolutions per second. There are 4 cylinders firing during each revolution.

#1 to #1 $\left(\frac{8 \text{ cylinders}}{4 \text{ cylinders/rev}}\right)$ (1/50 sec/rev) = 1/25 sec

#1 to #8 $\left(\frac{4 \text{ cylinders}}{4 \text{ cylinders/rev}}\right)$ (1/50 sec/rev) = 1/50 sec

#1 to #6 $\left(\frac{1 \text{ cylinders}}{4 \text{ cylinders/rev}}\right)$ (1/50 sec/rev) = 1/200 sec

#8 to #7 $\left(\frac{2 \text{ cylinders}}{4 \text{ cylinders/rev}}\right)$ (1/50 sec/rev) = 1/100 sec

#1 to #5 $\left(\frac{3 \text{ cylinders}}{4 \text{ cylinders/rev}}\right)$ (1/50 sec/rev) = 3/200 sec

B. Problems without solutions.

1. A No. 2 grade plank may have a split equal in length to 1 1/2 times the width of the board. What length of a split is allowed for a 2" x 8" plank which is 12 feet long?

Definition : No. 2 Grade -- quality classification of lumber

2 x 9 Plank -- a board 2 inches thick and 8 inches wide.

Complete solutions to B problems.

1. Split allowance = (1 1/2) (width of board)

= (1 1/2) (8")

= (3/2) (8")
= (24/2")

= 12 "

A. Problems with solutions.

1. A 1.5K 1 Watt resistor has burned open due to a shorted capacitor in a stereo power amplifier. You check the stock shelf and find only the following 1 watt resistors, all with a +10% tolerance from color coded values: 500 OHMs, 3.0K OHMs, 610K OHMs, 3.3K OHMs, 6.0K OHMs. The customer will not wait for parts to be ordered so you must substitute. Using two resistors in parallel, which combination will result in a value closest to the desired 1.5K OHMs? Find the highest and lowest possible resistance of the pair selected, considering the +10% tolerance of each.

   Ref: For two resistors in parallel

   $$\text{total} = \frac{R_1 R_2}{R_1 + R_2} \quad \text{(product over sum method)}$$

   1K = Kilo = 1000

   Solution:

   1. Since the total of parallel resistors is always <u>less</u> than the <u>smallest</u> resistor, the 500 OHM unit is ruled out.

   2. By trial and error (all values in KILOHMs):

   $\frac{(3.0)(6.0)}{3.0 + 6.0} = \frac{18.0}{9.0} = 2.0\text{K OHMs}$

   $\frac{(3.0)(3.3)}{3.0 + 3.3} = \frac{9.9}{6.3} = 1.6\text{K}$

   $\frac{(3.0(2.0)}{3.0 + 2.0} = \frac{6.0}{5.0} = 1.2\text{K}$

   $\frac{(6.0)(3.3)}{6.0 + 3.3} = \frac{19.8}{9.3} = 2.1\text{K}$

   $\frac{(6.0)(2.0)}{6.0 + 2.0} = \frac{12.0}{8.0} = 1.5\text{K}$

   <u>HIGHEST RESISTANCE</u>

   *** $\frac{(6.6)(2.2)}{5.4 + 1.8} = 2.01\text{K}$

   <u>LOWEST RESISTANCE</u>

   *** $\frac{(5.4)(1.8)}{6.6 + 2.2} = 1.10\text{K}$

   NOTE THAT THE 10% FACTOR COULD <u>NOT</u> OPERATE DIRECTLY ON THE 1.5K RESULTING VALUE.

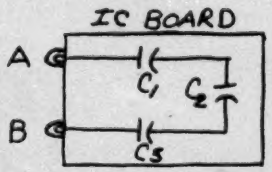
B. Problems without solutions.

2. Number 16 AWG solid annealed copper wire has a resistance, R at room temperature of 4.09 OHMs per 1000 feet. You are to wind a DC solenoid (relay) which will draw a current,I, of 1.3 amperes when 12 volts DC is applied. How many feet of #16 wire will be required?

   Ref: OHMs Law $R = \frac{V}{I}$

   Note: American Wire Gage : AWG
   Direct current : DC

3. While troubleshooting an integrated circuit board suspected of containing a shorted capacitor, you find that test points are available as indicated in the sketch below:



c = 5 microfarads* (mfd)

c = 10 microfarads (mfd)

c = 25 microfarads (mfd)

Microfarads = millionths of a farad

If a capacitive bridge were applied at points A-B, what would be the total capacitance, c , read on the instrument:
a) Id c , c , and c were okay? B. if c were shorted?
c. if c were shorted? Express answers in decimal form.

Ref. Series capacitors combine according to: $c_T = \frac{1}{\frac{1}{c_1} + \frac{1}{c_2} + \frac{1}{c_3} + \ldots \frac{1}{c_n}}$

Complete solutions to B problems.

2. Find the necessary resistance R

$$R = \frac{12 \text{ volts}}{1.3 \text{ Amps}} = 9.231 \text{ OHMs}$$

Determine the length of wire, L

$$*** \; L = (9.231 \text{ OHMs}) \left(\frac{1000 \text{ feet}}{4.09 \text{ OHMs}} \right) = 2257 \text{ feet}$$

3. A. $c_T = \dfrac{1}{\frac{1}{5} + \frac{1}{10} + \frac{1}{25}} = \dfrac{1}{\frac{10 + 5 + 2}{50}} = \dfrac{1}{\frac{17}{50}} = \dfrac{50}{17} = 2.94 \text{ mfd}$

B. $c_T = \dfrac{1}{\frac{1}{5} + \frac{1}{25}} = \dfrac{1}{\frac{5 + 1}{25}} = \dfrac{1}{\frac{6}{25}} = \dfrac{25}{6} = 4.17 \text{ mfd}$

C. $c_T = \dfrac{1}{\frac{1}{10} + \frac{1}{25}} = \dfrac{1}{\frac{5 + 2}{50}} = \dfrac{1}{\frac{7}{50}} = \dfrac{50}{7} = 7.14 \text{ mfd}$

ALTERNATE SOLUTION: Pairs of series capacitors can be combined into a an equivalent using the product over sum technique:

$$c_{1,2} = \frac{c_1 \, c_2}{c_1 + c_2} \text{ , ets.}$$

A. $c_{1,2} = \dfrac{(5)\ (10)}{5 + 10} = \dfrac{50}{15} = \dfrac{10}{3} \text{ mfd}$

$$c_{1,2,3} = c_T = \frac{\left(\frac{10}{3}\right)(25)}{\frac{10}{3} + 25} = 2.94 \text{ mfd}$$

B. $c_{1,3} = c = \dfrac{(5)\ (25)}{5 + 25} = \dfrac{125}{30} = 4.17 \text{ mfd}$

C. $c_{2,3} = c = \dfrac{(10)(25)}{10 + 25} = 7.14 \text{ mfd}$